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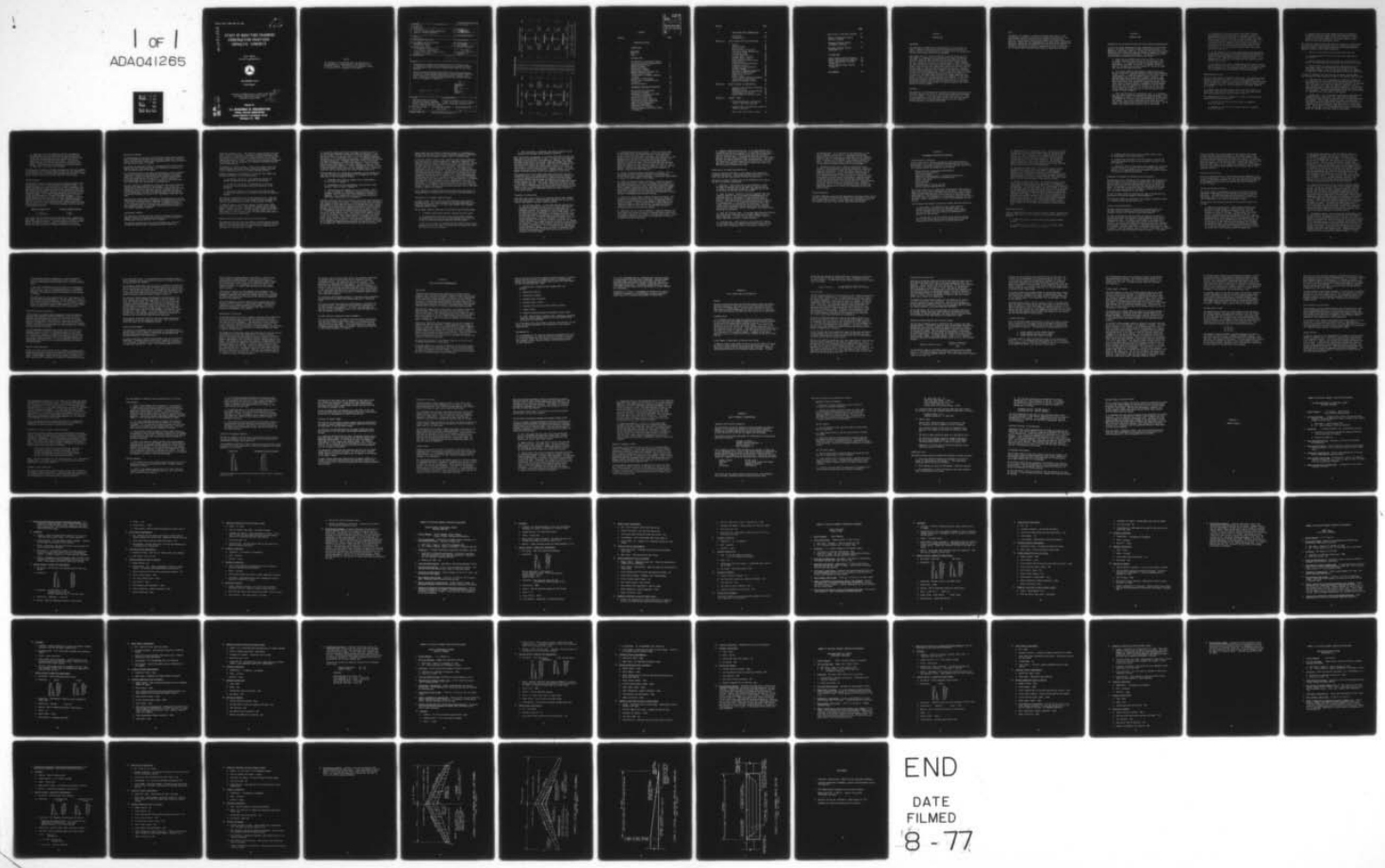

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STUDY OF NIGHTTIME PAVEMENT CONSTRUCTION PRACTICES-ASPHALTIC CONCRETE

W.P. WILLS
Consulting Engineers

DECEMBER 1976

Final Report

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JUL 5 1977

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16. Abstract

The magnitude of scheduled airline operations at civil airports has made it imperative that runway repair and overlay with hot mix asphaltic concrete be accomplished at night so as not to interfere with normal airline flight schedules.

Technical data and recommended construction practices such as working hours, construction lighting, automatic grade control, standby equipment, compaction, construction of transition and other related items are discussed in this study. Experiences of nighttime overlay construction at seven (7) municipal airports are documented in Appendix "C".

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METRIC CONVERSION FACTORS

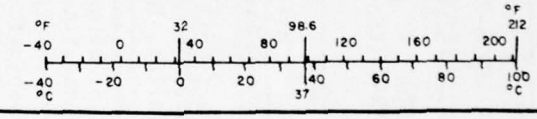
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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CONTENTS

Section		Page
	CONVERSION FACTORS	
1	INTRODUCTION	1
	Background	1
	Objective	1
	Scope	2
2	TECHNICAL DATA	3
	Coordination of the Overlay Project by Airport Authority Representative	3
	Nighttime Working Hours	4
	Standby Equipment	6
	Obstruction Lighting	7
	Construction Lighting	7
	Asphalt Compaction Equipment and Density Control Strips	8
	Installation of In-Runway Lighting Fixtures	10
	Precaution in Construction	11
	Premium Costs for Nighttime Construction	13
	Pre-bid Conference	14
3	RECOMMENDED CONSTRUCTION PRACTICES	15
	Pre-construction Conference	15
	Construction Schedule	16
	Assembling of Equipment for Nighttime Overlay Operations	17
	Application of Tack Coat	18
	Setting the Erected Stringline	18
	Traveling Stringline Operations	20
	Asphalt Placing Operations	20
	Compaction Requirements	21
	Construction of Transition	22
	Painting Temporary Centerline Stripe and Numbers	23

Section		Page
4	CONCLUSIONS AND RECOMMENDATIONS	24
	Conclusions	24
	Recommendations	25
APPENDIX A:	LEVEL SURVEYS AND PLAN PREPARATION	27
	General	27
	Pavement Survey	27
	Cross-Sections	28
	Plotting Cross-section Data	29
	Determining Runway Gradient and Transverse Slopes	29
	Finished Grade Data	30
	Pavement Repair, Flexible	31
	Pavement Repair, Rigid	32
	Porous Asphalt Friction Course	33
	Runway Grooving	33
	Protection of Existing Airport Lighting Fixtures	34
	Pavement Surface Preparation	34
	Flexible Pavement	35
	Selection of Aggregate Gradation	36
	Selection of Asphalt Cement	37
	Selection of Tack Coat	38
	Asphalt Plants	38
	Hot Mix Asphalt Spreading Equipment and Automatic Grade Control	39
	Methods of Automatic Control	40
APPENDIX B:	QUALITY CONTROL OF CONSTRUCTION	41
	Inspection and Testing of Materials	41
	Temperature Tests	43
	Checking Elevation of Completed Mat	44
	Straightedge Requirements	44
	Opening Runway to Aircraft Traffic	45
APPENDIX C:	AIRPORT STUDIES	46
	Baltimore-Washington International Airport, Baltimore, Maryland	47
	Greater Buffalo International Airport Buffalo, New York	52
	Dallas Love Field, Dallas, Texas	56

	Page
Adams Field, Little Rock, Arkansas	61
Norfolk International Airport Norfolk, Virginia	66
Shreveport Regional Airport Shreveport, Louisiana	70
Washington National Airport Washington, D.C.	75
ILLUSTRATIONS	
Typical Overlay Section (Figure 1)	80
Typical Overlay Section (Figure 2)	81
Typical Longitudinal Transition (Figure 3)	82
Typical Pavement Repair Section (Figure 4)	83
BIBLIOGRAPHY	84

SECTION 1

INTRODUCTION

BACKGROUND

The magnitude of scheduled airline operations at civil airports has made it imperative that runway repair and overlay with hot mix asphaltic concrete be accomplished in such manner as not to substantially interfere with normal airline flight schedules.

Even though the civil airport might have a parallel runway facility, the number of scheduled aircraft operations will deem it mandatory that both runways be made available for aircraft operations in the daytime in order for the airlines to maintain their flight schedules for the convenience of the ever increasing number of public travelers. Any major airport that has enough aircraft traffic to warrant a parallel runway cannot maintain their operational capabilities with one parallel runway closed in order to allow for daytime construction. Therefore, the best means to accomplish this purpose is for the airport authority to require nighttime construction. By this method the runway is closed at night for a pre-determined period and during the closure period, aircraft will use other runway facilities or suspend operations altogether for both air carrier and general civil aviation. In any event, serious and favorable consideration should be given at all times to performing the entire work at night to prevent closing of the runway during peak daytime travel periods for repair and overlay with hot mix asphaltic concrete pavement.

OBJECTIVE

The objective is to determine what nighttime construction practices with asphaltic concrete will result in satisfactorily constructed pavements for civil airports. This report will include criteria that will apply to the preparation of plans and specifications for repair and overlay projects which will allow the maximum amount of hot mix asphaltic concrete pavement to be placed each night.

SCOPE

In general, this report is a review of the past experience in nighttime pavement construction practiced at selected civil airports. This study will be limited to practices with asphaltic concrete paving which will permit normal aircraft traffic after each night's construction operation. Conclusions and recommendations are based on the construction procedures followed at the selected civil airports as well as the experience of the author on overlay of runways at military airfields and civil airports where nighttime construction procedures were followed.

SECTION 2

TECHNICAL DATA

Coordination of the Overlay Project by Airport Authority Representative

It is of the utmost importance that the representative of the airport authority in charge of the work, either a consulting engineer or an employee of the airport authority, be familiar with the various airline operations of the airport and have the necessary judgment to schedule the contractor's activities accordingly. The specific duties of the airport authority representative should be as follows:

1. Check with the weather bureau prior to 8:00 p.m. to see if weather conditions would be safe for the contractor's work that night. It is important to know the minimum temperature predicted for the night, if rainfall is expected, and to be aware of any possibility of fog "creeping in" during the night, thus causing instrument conditions.

2. The airport authority representative should evaluate the weather conditions to determine whether to direct the contractor to work or not. It should be the policy of the airport authority representative to follow the weather bureau's forecast. Any weather bureau report predicting a chance of rainfall greater than 50% should be cause for suspension of work for the night. There should never be an attempt to outguess the weather bureau. There could be instances based on information from the weather bureau that work was suspended but actually no rain fell and the sky was clear; however, it is critical that all decisions on this matter be on the safe side in order to prevent interruption of flight schedules.

3. After the contractor has reported for work, it is necessary that the airport authority representative check with each airline independently to see if all arriving and departing flights would be completed by 11:00 p.m. which would require the use of the primary runway. Each airline operations chief should be given a letter size sketch showing the work area for each night. The FAA control chief should also be given a copy of the sketch.

4. At the start of the night's work, the airport authority representative should confer with the contractor's project superintendent and there should be an agreement made as to how much work to layout for the night in order to insure the opening of the runway promptly at the specified time each morning. It is necessary that the amount of work be strictly controlled in order to prevent the contractor from becoming "over ambitious" and unable to finish the work within the allotted time. This is especially true in areas where pavement repair and replacement are to take place.

5. At the completion of work each morning and before the opening of the runway each morning, the airport authority representative should pick up representatives of the various airlines for an inspection of the runway before opening to aircraft traffic. It is mandatory that no FOD be on the runway and the inspection should satisfy the airlines.

6. All contacts with the U.S. Weather Bureau, the Federal Aviation Administration and the airlines should be made by the airport authority representative. The contractor should not be allowed to directly contact or have any dealings with the organizations.

Nighttime Working Hours

Time is of the essence on nighttime construction. The contractor should be given as much time as possible to overlay the runway each night. A period of time from 11:00 p.m. to 6:30 a.m. should be the least specified and if possible the flight schedules should be altered to permit closing of the runway at 10:00 p.m. with the opening of the runway scheduled for 7:00 a.m.

In no event should any work normally start later than 11:00 p.m. in the contract specifications; however, in the case of standby delays, work could be permitted to start as late as 1:00 a.m.

The scheduling of the work to commence at 11:00 p.m. should be predicated on the following conditions:

1. Arrival of jet aircraft at the airport as scheduled prior to 11:00 p.m.

2. Departure of jet aircraft from the airport as scheduled prior to 11:00 p.m.

3. Unrestricted use of other runway facilities for operation of propeller and jet-turbine aircraft which would permit the closing of the primary runway for overlay operations. With approval of the airport authority, the airport could be closed during construction operations at night.

The contractor should be told that delays or suspension of construction activities might be expected during the time allowed the night work period on account of the following conditions arising which would be beyond the control of the airport authority:

1. Arrival of jet aircraft at the airport after 11:00 p.m.

2. Delayed departure of jet aircraft from the airport due to late arrival.

3. Weather conditions which require the use of the primary runway for instrument operation of propeller and jet-turbine aircraft.

4. Wind directions and velocities which necessitate the use of the primary runway for the operation of propeller-driven and jet-turbine aircraft. This is only necessary when it is agreed to keep other runway facilities open during construction operations.

In order to compensate the contractor for the delays outlined above the following bid items should be included in the contract specifications:

1. Suspension time - This item should be specified to compensate the contractor for the notification by the proper authorities not later than 8:00 p.m. that work for the entire night will be suspended. This notification will allow the contractor sufficient time to alert personnel not to report for work as scheduled. The contractor should be required to bid on "suspension time" by the sum per night for such delays. The bid schedule should contain an estimated amount of "suspension time" which might be anticipated.

2. Standby time - This item should be specified to compensate the contractor when he reports for work, after having received no notification prior to 8:00 p.m. that activities for the night would be suspended. After having reported for work, the contractor, if notified by the proper authorities, should be paid by the hour for "standby time" for a period not later than 1:00 a.m. of the work night. The contractor should be required to bid on "standby time" by the sum per hour. The bid schedule should contain an estimated amount of "standby time" which might be anticipated.

3. Down time - This item should be specified to compensate the contractor for the condition which arises when the contractor has stood by until 1:00 a.m. and then is notified that no work will be performed that night and will be paid for "down time" for the remainder of the night. The contractor should be required to bid on "down time" by the hour for such delays. The bid schedule should contain an estimated amount of "down time" which might be anticipated.

The inclusion of suspension, standby, and down time in the bid schedule is the best means to secure the lowest bid price for the construction of the project. By this method, the contractor does not have to assume delays in his bid which will increase the cost of the project.

Standby Equipment

The contractor should be required to provide standby equipment at the construction site for all work included in the specifications. The standby equipment shall be provided for all types of equipment to be used in the required construction operations. The proper authorities may require that the standby equipment be interchanged with the regular construction equipment. Operators should not be required for the standby equipment. The standby equipment should not be used except in the case of emergencies or regular equipment breakdown. The standby equipment should be listed in the daily equipment as usually required by the contract specifications. When standby equipment is required to be used, the contractor should be required to promptly repair or replace the broken equipment before being allowed to proceed with the next night's work. The standby equipment should be required in the following amounts:

Regular Equipment Used	Standby Equipment Required
1 - 6 units	1 unit
7 or more units	2 units

In all cases the contractor should be required to park standby equipment readily available to the construction area in the event of breakdown of the regular equipment. Suitable equipment should be provided for the rapid movement of the asphalt spreaders and in no event should crawl-type spreaders be allowed to transverse grassed areas.

Obstruction Lighting

At the beginning of each night's work and after having received instructions to proceed with the work from the airport authorities' representative, the contractor should place illuminated traffic cones to blockoff any connecting taxiways if required.

At the ends of each night's work all illuminated traffic cones must be removed from the runway and stored in the contractor's work area outside the approach zone of the runway.

The illuminated traffic cones should be fabricated of highly pigmented translucent, fluorescent red-orange polyvinyl chloride. Each cone should be a minimum of 28 inches high and the bottom inside diameter of the cone should be not less than 10.5". The base should be of sufficient weight and size or should be anchored in such manner that the traffic cones will stay upright in a strong wind.

The cones should be illuminated by setting each cone over an operating lighting unit placed directly on the pavement. The lighting unit should consist of one or more 6-volt dry cell batteries and a #27 lamp. The battery should be of sufficient capacity to operate the lamp at full brilliancy for a minimum of 5 hours and should be provided with a polarized receptacle on top which will accomodate a lamp socket and lamp.

The contractor should replace batteries in the lighting units when the brilliancy of the lamps becomes inadequate as determined by the engineer. If any light in the cone fails or the cone is damaged, displaced or not in an upright position, from any cause, the contractor should require immediate repair or replacement or should restore the cone to its original acceptable condition.

Construction Lighting

The contractor should be required to install, maintain and relocate temporary lights to illuminate the working areas during the hours of darkness when overlay operations are in progress.

The lighting equipment should be trailer mounted units, each with 4-1,000 watt metal halide or high pressure sodium lights on a

winch-lift telescopic mast. The contractor should provide sufficient units to have the capacity of producing an average maintained illumination level of 5 horizontal foot candles throughout the working area. The contractor should be required to submit isolux curves or charts showing the pattern of lights. Levels should be calculated and measured in accordance with the standards of Illumination Engineering Society (IES) current practice.

In addition, all paving machines, rollers, distributors trucks and other equipment (except haul trucks) should be equipped with artificial illumination sufficient to safely complete the work.

Minimum illumination level should be 5 horizontal foot candles and should be maintained in the following areas:

1. An area 25' wide and 12' long immediately behind the asphalt spreader during the operation of the machine.

2. An area 12' wide by 30' long immediately in front and back of all rolling equipment during the operation of the equipment.

3. An area 12' wide by 12' long at any point where an area is being tack-coated prior to placement of the hot mix asphaltic overlay.

The level of illumination can be accomplished with four -1,000 watt metal halide floodlights at 30' mast height aimed at 60 degrees and placed at approximately 200' centers along each edge of runway.

A 1,000 watt lamp in metal halide produces 111,000 initial lumens while the 1,000 watt lamp in high pressure sodium produces 140,000 lumens. However, the color correction in metal halide is considered better and actually whiter. The high pressure sodium light is one that produces a sort of golden light. The metal halide lamp acutally gives a more nearly daylight effect.

Asphalt Compaction Equipment and Density Control Strips

The compaction equipment should be capable of obtaining the specified density without detrimentally affecting the hot mix asphaltic concrete overlay. The equipment should be modern efficient compacting units satisfactory to the engineer in charge.

It is generally agreed that roller techniques and operator capacity are the two most important elements in compaction operations. Compaction techniques for hot mix asphaltic concrete pavements generally are initial rolling (breakdown) that follows the spreading operation immediately or as soon as possible thereafter, as densities are achieved at higher temperatures. Breakdown with static rollers should begin with material temperature of 250 to 260 degrees F. Static rolling on materials above 260 degrees F will have a tendency to create a longitudinal displacement condition. Further intermediate and final rolling is delayed because marked cooling of the compacted course is necessary. Otherwise, serious displacement and surface checking may result.

Although there will be a change due to aggregate size and bitumen content, the following rolling temperatures are a suggestion for ideal compaction of the hot asphaltic mixture:

1. Breakdown with 3 wheel or tandem roller at 260 degrees F (plus or minus 15 degrees F)

2. Intermediate rolling with pneumatic tired rollers at 200 degrees F (plus or minus 15 degrees F)

3. Finish rolling with tandem roller at 175 degrees F (plus or minus 15 degrees F) Atmospheric conditions, viscosity, and equipment variations may alter these temperature limitations somewhat. This is especially true for nighttime construction where lower temperatures can be expected.

Vibratory rolling of the hot mix asphaltic mixture has been performed in some overlay projects with success. Vibratory rollers exert considerably more compactive effort per pass than do the conventional static rollers. Consequently, a fewer number of passes are required to achieve maximum density. Rolling patterns are therefore much more critical and should be determined for each overlay project by the use of density strips. It is considered necessary to establish density-growth patterns through the use of nuclear-density tests. With greater forces applied to the surface by vibrating rollers, over-rolling can be as much of a problem as too little rolling. Once optimum density is obtained, additional passes of the vibrating roller can crush the large aggregate particles and a subsequent loss in density. The importance of operator experience on all compaction equipment and particularly on vibrating rollers cannot be overemphasized. With the many variables involved in obtaining a

dense, smooth hot mix asphaltic concrete surface, it is extremely important that the operator follow good established compaction procedures and make the required number of passes over all overlayed areas.

If possible, density control strips should be constructed to determine the target density, optimum temperatures, compaction procedures, and number of passes for proper compaction of the hot mix asphaltic concrete. This density control should be constructed under nighttime conditions on areas other than the runway to be overlayed. The control strip should have an area of approximately 400 sq. yds. and should be the same depth as the overlay course. The density of the compacted mixture should be determined by means of a portable nuclear density test device in accordance with ASTM D-2950 or AASHO T-238. Upon completion of the compaction, the mean density of the control strip should be determined by averaging the results of ten nuclear density tests taken at randomly selected sites within the control strip. The mean density of the control strip should be the target density of the remainder of the course it represents. If the mean density of the control strip is less than 98% of the density of laboratory compacted specimen of the same mixture the engineer in charge should consider corrective measures such as additional rolling or change in mix design.

It is important on nighttime overlay construction that the engineer in charge designate an inspector full time to check on rolling operations.

Installation of In-Runway Lighting Fixtures

In-runway fixtures can be installed along with the hot mix asphaltic concrete overlay. The overlay presents an excellent opportunity to replace high maintenance costs of inset light systems with a pavement integrated conduit system.

The in-runway lighting system may be installed in the following manner:

1. A conduit system should replace a saw-kerf and wire system.

2. An opening should be bored in the existing asphalt pavement and light fixture base set and the space between coring and light fixture filled with compound compatible with the asphalt.

3. Slot for the conduit as required should be sawed in the direction desired and after the conduit is placed, the slot should be filled with quick set sealing compound.

4. After the sawing is completed, the overlay should be cored directly over the base and an extension installed.

After the overlay is completed, it is usually difficult to locate the bases which are buried and out of sight. It takes excellent surveying technique to plan and place inset monolithic lighting. One scheme for locating the bases is to provide a temporary plywood cover which protrudes slightly above the surface. When the hot mix asphaltic concrete overlay is placed, the "shadow effect" causes a reflection in the surface to visibly locate the exact location to core. Since the coring removes more than the material of improper density, no lasting damage is caused by having insufficient compaction at this point.

The compound used to seal around light bases and to fill slots for conduit should be a type manufactured for that particular purpose and is entirely compatible with the hot mix asphaltic concrete overlay. An instance has been reported where the material to be used around conduits swelled to such an extent that objectionable bumps were caused in the pavement every 50'. The conduit system and light bases should be installed at nighttime with the same construction period as for the runway. Time is of the essence in placing these light fixtures and conduits and this particular requirement should be clearly pointed out in the specification.

Precaution in Construction

There have been instances where the completed overlays were somewhat less than satisfactory. Detailed studies indicate that the following factors contributed to the unsatisfactory overlay.

1. Lack of grade control. It was found that the specification for the overlay project did not contain a clause requiring the contractor to construct the overlay to the plan grade with tolerances applied. The tolerance of the finished surface should be within 0.02 to 0.03 hundredths of a foot of plan grade. In one reported instance, the grade of the runway varied from three to four inches off the planned grade, with some areas being low and some areas high. Extensive straightedge inspection will not correct pavements which are way off grade. The proper way to control the grade is to require erected stringline for all courses of the overlay. These grades should be checked each morning before the runway is opened to airline traffic and results reported daily to the engineer in charge. If it is found that the intermediate courses are within the tolerances specified, consideration might be given to the placing of the final course by the use of the traveling stringline method.

2. Construction period was too short. The most critical areas in the surface course of the overlay occurs at the transverse joints at the end of each night's overlay. These joints are always difficult to construction and could cause rough areas in the pavement unless extreme care is taken during construction. The construction should be so planned that approximately 800' of overlay is placed each night. This will mean that the contractor should be scheduled to start work not later than 10:00 p.m. and opens the runway to aircraft traffic promptly at 7:00 a.m. the next morning. Construction operations should not be scheduled, in general, to begin later than 11:00 p.m.

3. Failure to properly design intersection of runways. All intersections should be carefully contoured so that elevations of the overlay can be readily determined. Longitudinal grade changes in excess of 0.1667% should not be allowed.

4. Failure to construct proper transition. Failure to construct the proper transition at the end of nighttime paving operations have been the complaint of pilots upon landing on the newly placed hot mix asphaltic concrete overlay. Reported incidents of damage to the aircraft landing gear due to short transitions and transitions being dislodged by jet aircraft blast have been reported. Details for construction of the transition are contained in section entitled, "Recommended Construction Practices."

5. Failure to provide proper transverse slope for drainage. Poor drainage of the runway overlay will occur unless the transverse slope of the runway overlay is one percent or preferably one and one-half percent. In the event the runway is side-sloped with a transverse slope less than one percent, consideration should be given to providing a third point or quarter point crown with transverse slopes not less than one percent.

6. Raked and "cast on" areas of pavement. Excessive raking of the final surface of the hot mix asphaltic concrete overlay should not be allowed. Raking and "casting on" of the mix could result in nests of segregated aggregate which could be dislodged by jet blasts or disturbed by grooving operations.

7. Adequate inspection and testing. It is important that the inspection and testing of materials for nighttime overlay construction be carried on in such manner as to assure strict compliance with the specifications. The inspection personnel should be familiar with the lighting condition at night reflect on the asphalt pavement and greatly magnifies ridges and depressions. The inspector should at all times be cognizant of the strict time for the opening of the runway and should assure himself each night that the construction schedule can be met.

Premium Costs for Nighttime Construction

It must be realized that there is some premium costs involved in nighttime construction. Each project should be analyzed for extra costs over and above what daytime construction would cost.

Following are items of premium cost to be considered in arriving at the cost of nighttime construction:

1. Materials - There should not be any difference in costs for materials whether the hot mix asphaltic concrete overlay is placed in the daytime or nighttime. Aggregate and oil may be delivered to the plant during the daytime.

2. Labor for paving - Normally it could be expected that some incentive should be used to influence the performance of the nighttime overlay. For example, if the contractor works 8 hours per night the contractor's personnel could be paid for 9 hours. There should not be any across-the-board pay increase for nighttime work. In the event the contractor works 6 days a week, there will be overtime for the sixth night. The contractor may be subjected to special union rules for nighttime work and this possibility should be thoroughly investigated before preparing cost estimates.

3. Labor for electrical work - It has been found that the electrical work involved in connection with in-runway lighting involves specialized labor. In order for this skilled labor to work at night, time and a half pay is usually necessary.

4. Lighting costs - Extra costs will be incurred for lighting of the runway during the nighttime construction period and also for the cost of providing lights on the asphalt spreader and

rolling equipment. It is possible for the contractor to rent the 4-1,000 watt lighting units as hereinbefore described. Based on 1976 rental prices, it is estimated that one lighting unit will rent for about $800 per month, exclusive of operating costs, including fuel and moving of the portable lighting fixtures. Extra cost will also be incurred in providing lights for the asphalt spreading machine and rolling equipment.

5. Estimating premium costs - When the preliminary project estimate is being prepared, the various contractors in the area should be questioned as to what they expect the extra cost for nighttime construction. It will be apparent that the idea of extra costs among the contractors will vary a great extent. It is probable that some of the contractors will report a rather high premium cost which should be discounted. When the project is actually advertised and bids received the contractors will reflect the premium costs in their bids which will be approximately 10% to 20% higher than daytime construction costs. Based on experience, the costs will be substantially lower than the cost quoted the engineer at the time of the preparation of plans and specifications.

Pre-bid Conference

A pre-bid conference should be held approximately two weeks before receipt of bids to acquaint all prospective bidders with the details of the work and to answer all questions. At the conference, representatives of the airport authority and FAA control tower should be present.

SECTION 3

RECOMMENDED CONSTRUCTION PROCEDURES

Pre-Construction Conference

Prior to the start of overlay construction, the airport authority should require that a pre-construction conference be held to discuss the features, requirements, and details for the nighttime construction. The conference should be attended by the following:

Airport Director or designated representative
Public Works representative
Consulting Engineer
Contractor's Superintendent or designated representative
Federal Aviation Administration representative
Control Tower Chief
Crash Crew Chief
Security Chief
Representatives of Various Airlines
Testing Laboratory Representatives

The airport director or his authorized representative should discuss in detail the various safety requirements of the airport. The contractor should be made cognizant of the fact that he will be working in designated areas and that employees will be required to stay within these designated areas. All personnel of the contractor should be required to park their personal automobiles in a certain area designated for that purpose.

The following items should be discussed in detail with the contractor:

1. Haul routes - The location of haul routes should be discussed with the contractor and decisions made on security, responsibility for trucks transporting the asphalt mix and any other items which relate to transportation of materials to the job-site.

2. Working hours - The exact working hours should be agreed upon so that notices can be given to the Federal Aviation Administration for distribution to the proper authorities.

3. Communication with FAA Control Tower - The contractor should be made aware that all communications with the FAA tower personnel will be made through the airport authority and not by the contractor. This is important as the number of people having contact with the tower should be limited in order to prevent misunderstanding or conflicting information. The airport authority should have direct radio contact with the FAA tower and all requests for closing and opening of the runway should be made by the airport authority representative.

4. Designation of Work Areas - Prior to the start of overlay operations each night, the airport authority should discuss the area to be worked and the contractor's superintendent should mark on a letter-size drawing the exact limits of the area to be repaired or overlayed. This drawing, marked as required, should be hand-carried to the airport director, FAA control tower chief, and the station manager of the various airlines.

5. Security during construction - The contractor should provide strict security during the overlay operations. This security should apply to both personnel and also to trucks hauling materials and equipment. In the event there is an active runway in the area, all personnel should be cautioned not to cross the active runway(s). At the intersection of active and closed runways, the contractor should erect adequate lighted barricades to prevent vehicles from crossing active runways. Prior to the start of construction all personnel and supplier should be given a drawing showing the haul routes, active runways (if any), and any other details pertinent to the overlay operations. The drawing should contain a note which states that anyone found in restricted areas or crossing active runways will be promptly and permanently removed from the job.

Construction Schedule

Prior to commencing work on the nighttime overlay project, the contractor should be required to file the following with the airport authority for approval:

1. A detailed progress schedule showing the proposed schedule of work.

2. A complete list of equipment to be used, including standby equipment as required by the specifications.

3. Evidence that the central hot mix asphalt plant(s) meet the requirements of the specifications.

4. Evidence that the amount of hot mix asphaltic concrete the contractor proposes to place can be supplied to the job in the time required.

5. Experience record of the project superintendent the contractor proposes to place in charge of the job. The experience record should list his experience on hot mix asphaltic concrete overlays, including any nighttime construction.

Assembling of Equipment for Nighttime Overlay Operations

The contractor will be advised by the airport authority representative that the night's work will proceed as contemplated. The contractor should assemble all personnel and equipment as close as possible to the work area which will be governed by the approach and transition zones. The equipment and personnel should be organized so that when notice is given, the contractor's personnel, including the survey crew, can proceed immediately to the runway.

All hot mix plants should be operating and ready to proceed with the production of the hot mix asphaltic concrete material.

The contractor should be assured that all equipment, including standby, is in operating condition and ready to go.

Limits of Overlay Operations.

The plans and specification as hereinafter discussed should show the exact limits of overlay and should indicate the amount of asphaltic concrete fill required at specified intervals.

In order to complete the overlay within the shortest time possible, the contractor should be required to place approximately 800 feet of overlay each night. This amount is predicated on the runway being available at 10:00 p.m. and opened for traffic the next morning at 7:00 a.m. By placing 800 linear feet of overlay each night, regardless of the width of overlay, the number of transverse joints will be held to a minimum. The whole width of the runway must be overlayed as shown by figure 1, with the exception that on a 200 ft. wide runway, the asphaltic concrete overlay should be placed as shown on figure 2. In no event

should a narrower strip be considered for the length of the runway. In preparing plans and specifications for the overlay project, the designer should ascertain the availability of hot mix asphalt plants in the area and the tonnage that the plants will produce. In instances where the overlay is thick enough to require several intermediate courses the plant capacity will be most important. The designer, after determining plant capacities can compute the thickness of the intermediate course or courses which should generally not be greater than 3 inches compacted thickness.

Application of Tack Coat

Tack coat should be applied on the existing pavement immediately prior to overlay operations. In all cases, the tack coat should be emulsified asphalt as hereinafter mentioned. The tack coat should also be applied to intermediate courses unless one overlay application immediately follows the other.

Setting the Erected Stringline

The airport authority representative should furnish the Contractor a tabulation of the asphalt fill as required for the night's overlay operations. The tabulation should show the asphaltic concrete fill requirements every 25' longitudinally and every 12.5' or 25' transversely depending on the width of the asphalt spreader.

The setting of the erected stringline for the various layers are as follows:

1. Bottom or leveling course - When erected stringlines are used for the bottom course or levelling course, the height of the fill should include an allowance of 3/16" per inch thickness to allow for roll-down. In other words, the stringline will be placed at the loose elevation of the mat. The erected stringline should be supported every 25' by pins welded to approximate 8" square metal plates with adjustable arms. The grade pins should be so designed as to allow the stringline to be secured to the adjustable arm without any protrusion above the stringline grade. The stringline should be set, anchored, and adjusted to the required grade and maintained with a force of no less than 80 pounds pull to prevent sag of the stringline. The anchoring of the stringline should not exceed 500'.

For the bottom course which is also the leveling course, it is recommended that spot leveling not be used as it will be too difficult to feather out the edges in isolated areas. It is also recommended that the runway, if a parallel runway exists, not be closed for leveling courses to be constructed in the daytime. The closing of one parallel runway in the daytime will cause too many delays in airline flight operations. The leveling course can be placed along with the bottom course by the method of placing the stringline at the rolldown elevation. In order for precise checking of the hot mix asphaltic concrete mat during placement, the stringline should be placed at the same elevation of the loose mat. By this method it will be easy to measure from the stringline to the loose mat by the use of a carpenter's level. In some instances, the stringline has been set from 4" to 18" above the required elevation. The placing of the stringline above the desired grade makes it difficult to measure down to check the mat elevation.

It is possible to place the hot mix asphaltic concrete overlay within 0.02' to 0.03' of plan grade if the following procedure is used. During the placing of the hot mix asphaltic concrete overlay, the contractor should constantly check both sides of the mat (for the initial lane placed) by measuring over from the stringline to the mat to determine grade compliance and by making the necessary adjustment in the electronic control devices. Immediately after rolling operations are completed, the contractor's field supervisor should determine the elevations of the pavement. These elevations should be taken every 25' transversely and every 12.5' or 25' longitudinally depending on the width of the asphalt spreader. The contractor should compare the "as built" elevations with the plan grades to determine if the 3/16" per inch rolldown assumption used was correct. The contractor should then furnish the airport authority representative with a copy of the grade elevations of the bottom course.

2. Intermediate courses - After the placing of the bottom course for the length of the runway, the contractor should be ready to commence with the intermediate course or courses. The airport authority representative should furnish the contractor with another copy of the asphalt fill for the intermediate course which should be the difference between the plan elevation and the elevation of the "as built" elevation of the bottom course plus 3/16" per inch rolldown assumption. During and after the placing of the intermediate course grade and elevation checks should be made as hereinbefore outlined for the bottom course. Intermediate courses should be held to an approximate compacted depth of 3 inches.

The procedures should be repeated for as many intermediate courses as required with close grade control exercised. The top or surface course should be placed 1½ to 2 inches compacted depth.

If the final intermediate course is found to be constructed to within 0.02' or 0.03' of the planned grade, it is recommended that the final course be placed using a travelling stringline. Otherwise, the contractor should be required to use an erected stringline.

The importance of strict grade control of all the courses of the overlay cannot be overemphasized. The best asphalt mix design and the best results on compaction are not sufficient if the overlay is not constructed to plan grade. It should be the responsibility of the airport authority representative to assure himself that the contractor is exerting care in his grade control.

Traveling Stringline Operations

If the runway is considered smooth enough not to require extensive leveling, the contractor should be permitted to place the hot mix asphaltic concrete overlay by the use of a traveling stringline. The traveling stringline may consist of a 30' to 45' ski, a wheel device or footed frame or similar device. When asphalt pavers are operated in echelon, the first paver will have a traveling stringline on both sides and the following paver will be equipped with a matching shoe and traveling stringline.

In no circumstances should the slope control device be used as the accumulative error in multiple lane paving since it will violate the grade control criteria. It should be pointed out that the use of a traveling stringline will expedite the placing of the material as no time is required at the start of the nighttime operations for setting the erected stringline. It can be reasonably assumed that approximately 30 minutes will be saved by permitting the traveling stringline method.

Asphalt Placing Operations

Prior to the start of the night's hot mix asphaltic concrete overlay operations, the airport authority representative and the contractor's project superintendent should agree on the limits of runway to be overlayed. As hereinbefore stated, the target length to be paved each night should be 800' regardless of the depth of the particular course

being placed that night. If conditions permit and the plant production is adequate, the length of the final course, if placed by traveling stringline, could be increased.

The contractor should begin placing the hot mix asphaltic concrete overlay in the direction of the usual prevailing wind so that the aircraft will be landing down the transition. There should be no skipping of sections. The overlay should cover the full width and a distance of 800' of the runway each night with the exception of a 200' wide runway, the asphaltic concrete should be placed as shown by figure 2.

The contractor should operate two spreaders in echelon either 12.5' or 25' widths and the spreaders supplied with hot mix asphaltic concrete from the two plants. For the final 1½ to 2 inch course, the first pass should be centered on the middle of the runway and each succeeding pass should proceed towards the edge of the runway. No overlay should be permitted in excess of the capacity of the plants and the capability of the two paving spreaders. In the event that the two plants cannot supply 25' wide spreaders the contractor should consider 12.5' wide placing. In no event should only one spreader be permitted as two spreaders operating in echelon are necessary to maintain a hot joint during nighttime paving operations.

The contractor should hold raking to the very minimum and casting of raked material on the mat should be prohibited. This restriction should also apply to the intermediate courses.

Compaction Requirements

The compaction requirements should be outlined in the specification and test control strips should be constructed as hereinbefore described. Rolling should secure a density in the mat of at least 98% of the laboratory density of the same mixture.

Two pavers operating in echelon should produce a hot joint for rolling operations. In-echelon paving and rolling is sometimes a problem as it is difficult to maintain a rolling pattern due to the congestion of the two pavers placing 12.5' lanes. This could be especially true of

the rolling by the heavy pneumatic tired rollers. After the two initial lanes are completed, there should be no difficulty in maintaining the rolling pattern. Rigid temperature control should be maintained during the rolling of all lanes but especially the initial two lanes. All longitudinal joints will be hot joints formed by leaving a 3" edge of lane unrolled until the adjacent lane is placed.

Thin layers of overlay on rigid pavement can be damaged by over-rolling with a tandem roller and the bond will be broken. On rigid pavements, experience has shown that greater density can be obtained on thick lifts than on thin lifts due to the crushing of aggregates during rolling operations.

All roller operators should be competent and be experienced since improper rolling resulting in a poor product requiring removal may cause delay in the scheduled opening of the runway. The airport authority representative should require prompt removal from the project any incompetent roller operator.

Construction of Transition

At the end of each night's hot mix asphaltic concrete overlay operations, it will be necessary that a transition be constructed to provide a transition from the completion of the particular course of overlay to tie into the existing pavement. The construction of this transition is one of the most important features of the nights operation. Too steep a transition will cause possible structural damage to the operating aircraft or malfunction of the aircraft's instruments when the runway is open to aircraft traffic.

The length of all transitions except the transition for the final surface course should be 50' measured longitudinally as shown on Figure 3. The transition should be constructed by the use of erected stringline; however, the asphalt spreader automatic controls should be cut-off at a depth of approximately 3/4" and then the material feather-edged by hand raking. The transition should be constructed as a permanent part of the overlay and need not be removed for the next night's operation when intermediate courses are involved. Leaving of the transition in place will save material and also save time by not having to remove and waste the transition material. Aggregates raked out at the joints should be disposed of and not cast on the mat. There are two acceptable options for constructing the transition for the surface course which should be 1½ inches to 2 inches of compacted depth.

The length of the transition should be 25' and should be constructed in the same method as specified for the 50' transition for the intermediate course. The transition can be left in place if the contractor has developed sufficient expertise to construct a joint which will meet specification requirements. The other option is sawing back the transition and removing the material in constructing a joint. Infra-ray heaters should be required to heat the transition at the point where the overlay ties into the previously placed transition. Aggregates raked out at the joints to provide a smooth transition should be disposed of.

The contractor should develop expertise in starting overlay operations at the transition and should also develop expertise in raking the joint.

All joints at transitions should be straightedged in accordance with the specifications. The above described transition construction is for 3/4" maximum sized aggregate. If larger sized aggregates are specified for the intermediate courses, the transition should be cut back and removed in all cases.

Painting Temporary Centerline Stripe and Numbers

Prior to the opening of the runway to aircraft traffic each morning, the contractor should be required to paint a 12" wide white stripe down the center of the runway. The stripe should be for distance overlayed the previous night. If the overlay begins at runway ends, a temporary white number should be painted. The markings should be 6" wide stripes painted on 12" centers.

SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

A study of the nighttime overlay operations at various airports indicates that is entirely feasible to repair and overlay an existing runway at night with hot mix asphaltic concrete. With a dense-graded hot mix asphaltic concrete overlay, aircraft can use the facility as soon as 1½ hours after the termination of actual asphalt placing. The quality of nighttime overlay obtained with proper inspection, adequate testing of materials and with strict grade control can compare favorably with the quality of overlays constructed during daytime.

When parallel runways exist at an airport, it is unwise to close one parallel runway for daytime leveling or for the placing of the final surface course. The closing of one parallel runway will cause delays in aircraft traffic and inconvenience to the traveling public. Once the contractor is set up to pave at nighttime and the paving crew is "broken in", there is no reason to perform any of the overlay work in the daytime.

Comparison of specified surface tolerances and "as built" grade elevations show that the claim that "a good job cannot be performed at night" is invalid and there is no justification to close a runway for daytime construction. Usually the runway to be overlayed is the instrument runway and the airport will be forced to cancel schedules or divert traffic to other fields to do daytime work. Daytime construction should be considered as an added expense to the airlines and the loss of revenue to the city which are over and above the premium cost involved in nighttime overlaying.

Any decision on the part of the airport authority to restrict work to daytime construction is unwarranted.

At present, there is no criteria to determine if the existing runway is smooth enough to be overlayed by the traveling stringline method in lieu of the erected stringline method. The use of the traveling stringline for grade control will expedite construction and eliminate the cost of establishing the erected stringline.

Much of the specifications for asphaltic concrete overlays for daytime construction can be used in the specifications for nighttime work. However, the nighttime specifications should contain the requirements for the following additional items:

1. Working hours, suspension time, standby time, and downtime

2. Obstruction lighting

3. Construction lighting

4. Pavement repair (flexible)

5. Pavement repair (rigid)

6. Protection of existing airfield lighting fixtures

7. Asphalt plants

8. Asphalt spreading equipment and automatic grade control

9. Other items relating to grade control, compaction, aggregate selection, asphalt cement selection, tack coat selection and construction of transitions.

All of the above items are outlined in Section 2 and Section 3 of this study and should be followed in the preparation of the technical specifications.

Recommendations

It is recommended in all cases that favorable consideration be given to overlaying runways at nighttime with hot mix asphaltic concrete as it has been proven that this method is the only way to maintain the pavements at major airports without interfering unduly with aircraft operations.

It is also recommended that no consideration be given to placing a porous asphalt friction course at nighttime. The open-graded mix without more curing time than the 1½ hours possible with nighttime construction will be subject to shoving, rutting, and displacement by aircraft. If desired, runway grooving in lieu of a porous friction course can be substituted to provide adequate skid resistance.

Development of criteria is recommended to determine the level of roughness or uneveness of existing runway surfaces which would permit the use of "traveling stringlines" in overlay work.

APPENDIX A

LEVEL SURVEYS AND PLAN PREPARATION

General

The plans and specifications for nighttime pavement repair and overlay should be presented in such detail as to allow ready determination of the limits of pavement repair, finished grades and depth of overlay. These plans and specifications will be used at night by the contractor and inspection personnel and should be clear and precise in every detail.

Pavement Survey

It is important that the runway be surveyed and elevations determined so that a decision can be made on whether the hot mix asphaltic concrete can be placed with grade control provided by the use of a "traveling stringline" or by the "erected stringline" method. This item is very critical as the use of the ski will allow increased production during the nighttime construction period. Experience has shown that approximately 30 minutes to an hour is required to set the erected stringline for the first two passes of the asphalt spreader. Pavement surveys should necessarily be run at night with artificial lighting as required to read the rod.

Establishment of Bench Marks by Rod and Level Survey

A complete system of bench marks should be set on the side of the runway to allow for ready reference during cross-sectioning operations. The bench marks should be set at approximately 400' intervals. Normally, the bench marks are set on the concrete light pad corners. A square

be made on the light pad to indicate the exact location to set the rod. It is preferable to run the bench marks using a Philadelphia rod for the best accuracy. The bench mark survey should conform to the following error of closure:

$$\text{Error of Closure} = .0175\sqrt{\text{length of level run in miles}}$$

Cross-sections

Flexible pavement should be cross-sectioned on 12.5' centers transversely and 25' centers longitudinally. On rigid pavements elevations should be taken on the joints. It will be found that transverse joint spacing for airport pavements is usually on 15, 20, or 25' centers. At the intersection of two joints, the elevation should be taken on the highest side of the joint. All elevations should be read to hundredths of a foot. In the level operations the levelman should always tie into the bench marks that are located along the side of the runway at 400' intervals as previously stated. If there is any difference in bench mark elevations, this difference should not be carried forward but the levelman should correct back to the elevation of the bench mark. In no case should these differences be accumulative.

For ease in recording elevations a plan of the runway should be prepared on the scale of 1"=20' or 1"=40' and the plan gridded in squares or rectangles with lines parallel to the centerline of the runway at 12.5' centers and transversely on 25' centers for flexible pavement and 15, 20, or 25' transversely for rigid pavement. The use of a Lenker Rod will enable the levelman to record the elevation directly and eliminate the reduction of the notes.

It will also be possible to survey the runway by the Laser profilometer system; however, this type survey will have to be performed at night in weather good enough to afford an unobstructed line of sight between the laser vehicle and the tracker vehicle.

Extreme care should be exercised in the level operations as the elevations are to be used in determining the depth of asphalt overlay. Only in extreme cases will it be necessary for any construction levels to be run at night for the setting of the erected stringline. In the event an expansive soil exists or there is consolidation of the base material, and this should be determined in the soils investigation, the contractor should be required to verify all bench marks and to report to the proper authorities any variation of over .03'.

Plotting Cross-section Data

Detailed cross-sections should be plotted from elevations taken from the grid sheets previously described in the sub-paragraph entitled "Cross-Sections." The scale to be used for plotting the detailed cross-sections should be 1"=0.40' vertical and 1"=40' horizontal. All grading plans should be drawn to a plan scale of 1"=40', the same as the profile. This exaggerated scale is necessary due to the fact that frequently the vertical scale used is not exaggerated enough to show the transverse and longitudinal breaks in the runway pavement. By the use of vertical scale of 1"=0.40', it will be possible to actually read the finished grades direct without any computations.

The centerline runway profile should also be plotted to the scale of 1"=0.40' vertical and 1"=40' horizontal. The use of this scale in plotting centerline runway profiles will allow for easy determination of the breaks and undulations in the existing pavements and will enable the runway gradients to be established more accurately.

On the same datum, the left and right edges of the runway should also be plotted, however the proper legend should be established to enable the designer to identify each edge. Any other profiles required should also be plotted on the same datum with an appropriate legend.

Determining Runway Gradient and Transverse Slopes

The new runway gradient should be determined from a study of the exaggerated profile. The depth of overlay should be determined from detailed engineering studies which is beyond the scope of this report; however, non-destructive testing should be considered in evaluating the strength of the existing runway. Once the depth of the overlay is determined, the gradients should be set with points of intersection of the tangents at least 1,000' apart. If possible the last 3,000' of the runway should have no break in grade. All grade changes in excess of 0.17 algebraic difference should be provided with vertical curves by use of the following formula:

$$\text{Length of vertical curve} = \frac{\text{Algebraic Difference}}{.1667}$$

The transverse slopes of the runway should be studied and every attempt (except at intersecting runways) should be made to provide a transverse slope of 1.5% to secure adequate drainage. In no event should the transverse slope be less than 1.0%.

Studies have indicated that approximately 95% of all take-offs and landings can be accomodated on a strip approximately 80' wide. This is the area that should be provided with a maximum 1.5% transverse slope without deviation and on the outside areas the slope can be modified as required, with a maximum of 2.0% considered to reduce the amount of overlay. In no event shall runway grades be warped to meet taxiway grades as the reverse is required, i.e. taxiway grades should be warped to meet runway grades.

In instances where side crowned runways are encountered every attempt should be made to introduce third point or quarter point crown. This will improve the drainage of the runway and will facilitate drainage of the grooved runway if this operation is to be performed as a part of the contract.

The plans should include a typical section, or more if required, which shows the depth of the overlay and the number layers to be constructed. When the transverse slope of the runway is improved to provide a 1.5% center crown the top course of the pavement should follow the 1.5% slope whereas the other courses will vary depending on the depth of the overlay. The typical cross-section should identify the sequence of lane placing and the required number of paving lanes.

Finished Grade Data

After the finished grades and transverse slope of the runway are determined a tabulation of the grades should be included in the plans for the contractor to use in bidding on the project and for establishment of the erected stringline. The tabulation of grades should be as follows:

1. Column showing existing runway elevation.
2. Column showing finished overlay grade.
3. Column showing total depth of overlay.

The grades should be shown longitudinally every 25' and transversely every 12.5'. It is considered that these grades will be a vital part of the contract plans as from the total depth of overlay the contractor can determine the depth of the overlay for each course.

The finished grades should also be shown in contour on the grading plan hereinbefore discussed. The finished contours should be indicated by a heavy line for every 0.50' with the elevation of the contour shown in a box. The tenth contours should be indicated by a light line.

Pavement Repair, Flexible

The identification of areas of flexible pavement removal and repair should be identified on the plans for bidding purposes and for the location of areas to be repaired. The appropriate drawing to show the location of pavement repair areas would be the 1" to 40' contour grading layout sheets. Prior to each night's construction, the airport authority representative should mark the areas to be removed that night. These areas should be marked in the company of the project superintendent or his authorized representative. Care should be taken not to remove more area than can be replaced before the time for the opening of the runway.

The pavement to be removed should be sawed with approved equipment to sufficient depth to remove the failed areas without damage to the adjacent pavement. The plans should show a typical section which indicates the depth of the asphalt pavement, base and sub-base as well as the classification and moisture content of the underlying earth subgrade.

The failed flexible pavement should be removed to the depth indicated on the plans or as directed until firm subgrade is reached. The actual depth of material to be removed is an on-the-spot decision that will have to be made by the airport authority's representative in company with the project superintendent. It is considered that the nighttime construction period is too short to allow for the scarification and recompaction of the earth subgrade. The most expedient construction procedure is to use the hot mix asphaltic concrete mix for the full depth of the area to be repaired. The mix to be used for the pavement repair may be the same gradation as the surface course mix and placed in 4" to 8" loose layers. Care should be taken in highly plastic clay to place the bottom course in sufficient depth to bridge the area so that no pumping of the underlying clay subgrade will occur. The compaction methods should be controlled so that the pumping of the underlying clay subgrade will be prevented. To prevent this condition, asphalt ramps should be constructed from the top of the pavement to the bottom of the repair area. The top of the asphalt ramp should be removed for the placement of the top layer to prevent any feather edge condition. Small repair areas not large enough to accomodate rollers should be compacted by manually operated vibrating rollers.

All pavement repair should be accomplished approximately 1½ hours before the opening of the runway as scheduled in order to allow the material to cool somewhat before being subjected to aircraft traffic. Past experience has shown that deep repair areas can be made with hot mix asphaltic concrete and successfully used by aircraft after the night's construction is completed. With the repairs made with well-graded hot mix asphaltic concrete and the compaction methods used as hereinbefore specified there is no danger of displacement of the surface of the completed repair area.

For pavement repairs at the ends of runways and adjacent connecting taxiways consideration should be given to repairing these areas in the daytime hours by the use of a displaced threshhold. This should only be after detailed studies are made of runway length requirements which would allow the use of a displaced threshhold. All standby equipment should be available during pavement repair operations. Figure 4 shows a typical section of pavement repair.

Pavement Repair, Rigid

The identification of areas of rigid pavement removal and repair for bidding purposes, the appropriate drawing to show the location of the repair and the delineation of the repair areas each night for rigid pavement are the same as for the flexible pavement described previously. For pavement removal complete slabs outlined by existing joints should be removed as experience has shown that the remaining portion of the rigid slab will eventually fail. PCC slabs usually are found to have the following joint pattern:

25' by 25'
15' by 12.5'
20' by 12.5'

The pavement should be removed by approved equipment and special care should be exercised not to damage the adjacent pavement. Care should be taken not to remove more slabs than can be replaced before the time of the opening of the runway. The plans should show a typical section which indicates the depth of the rigid pavement (including any reinforcing steel), sub-base as well as the moisture content and in-place density of the underlying earth subgrade.

The failed PCC slabs should be removed as indicated on the plans or as directed by the airport authority representative. The sub-base including earth subgrade should be removed until firm subgrade is reached. The actual depth of material to be removed is an on-the-spot decision that will have to be made by the airport authority representative in company with the project superintendent. It is considered that the nighttime construction period is too short to allow for the scarification and recompaction of the earth subgrade.

The most expedient construction procedure is to use the hot mix asphaltic concrete mix for the full depth of the area to be repaired as previously described for flexible pavement repairs. The compaction methods, completion of repairs, use of displaced threshhold, and availability of standby equipment should be the same as specified for the flexible pavement repair.

Porous Asphalt Friction Course

Porous asphalt friction courses should not be constructed during nighttime and immediately opened to aircraft traffic in the morning. The porous asphalt friction course is an open-graded mixture placed with a high bitumen content and will be subjected to dislodgment of aggregates and scuffing by aircraft tires if opened to aircraft traffic almost immediately after completion of rolling operations.

No vehicular traffic should be permitted on the porous asphalt friction course until it has cured for at least 12 hours. Completed areas should not be opened to aircraft traffic for seven days after construction. This requirement will rule out the use of porous asphalt friction course for nighttime overlay projects as hereinbefore stated.

Runway Grooving

In general, grooving of the completed hot mix asphaltic concrete overlay should not commence until at least 60 to 90 days after the completion of the asphaltic concrete. This curing period should prevent plastic flow of the mix. However, some airports have grooved much sooner than 60 to 90 days. At one airport, grooving was initiated approximately 24 hours after completion of overlaying with asphaltic concrete. The grooves performed satisfactorily. Other airports grooving after much longer periods of curing also reported satisfactory performances. Thus the required period before asphaltic concrete can be grooved has not been definitely established.

The recommended groove pattern is 1/4 inches by 1/4 inches with center spacing of from 1½ inches to 2 inches. The grooving operations should be continuous for the complete length of the runway and sawed transverse (perpendicular to the runway centerline). The grooving should terminate within 10' of the runway pavement edge to allow for the operation of the grooving equipment. It is important that the finished surface of the hot mix asphaltic concrete overlay be constructed in such a manner as not to have any nests of segregated or cast-on coarse aggregate. These areas of objectionable material will not hold up under grooving operations and the sawed aggregates will be subjected to dislodgement by jet aircraft blasts.

It will be necessary that all grooving operations be scheduled for nighttime construction with the same work period as specified for the overlay in order to prevent closing of the runway.

Protection of Existing Airport Lighting Fixtures

All existing airfield lighting fixtures along the edge of the runway and any in-runway lighting fixtures should be indicated on the drawings so that the contractor will have knowledge of the fixtures requiring protection or adjustment. Any fixtures requiring adjustment in elevation should likewise be clearly indicated and details shown for adjustment. The specifications should include a paragraph which places a monetary penalty for any light so damaged. The phrase in the specifications should read substantially as follows:

> "The contractor shall be responsible for the protection of existing lighting fixtures as indicated. The contractor shall pay the city the sum of $200.00 for any fixture so damaged and requiring repair and/or replacement by the city airport maintenance personnel."

Note: The value of $200.00 for the lighting fixture is for informational purposes only. The actual value of the lighting fixtures should be determined by the airport authority.

Pavement Surface Preparation

The plans and specifications should clearly indicate the requirements for pavement surface preparation. A thorough survey and inspection of the runway should be made by the airport authority representative prior to the preparation of the detailed plans and specifications.

The requirements for pavement surface preparation are as follows:

Rigid pavement

1. Spalls along pavement joints exceeding 1" in width and 4" in length should be removed by sawing the slab approximately 1" back of the spalled concrete and then removed to sufficient depth until sound concrete is reached. The area should be backfilled with the same mixture as specified for the hot mix asphaltic surface course or with fast setting commercial patching materials. The mixture should be thoroughly compacted with hand tampers or with hand operated vibrating mechanical tampers.

2. It is not considered necessary to remove rubber deposits from the runway provided the overlay thickness is two inches or greater. If it is desired to remove the rubber build-up, the material may be removed by high pressure water jets, chemicals, high velocity particle impact or mechanical grinding.

3. Paint markings should be removed from the runway surfaces as the presence of the paint markings could interfere with the bonding of the overlay to the surface. The paint markings may be removed by high pressure water jets, high velocity particle impact or mechanical grinding.

4. There is no reason to remove existing joint sealing material from the joints in the rigid pavement unless the sealing material protrudes above the pavement surface and there is excess sealing material on the surface. If this condition exists, the sealant material should be removed by plowing or other methods to a depth of 1½ inches and filled with a sand emulsion mixture. The excess sealing material should be removed from the surface of the pavement by blading or grinding or other approved method.

Flexible pavement

1. All failed areas in the pavement should be repaired as hereinbefore discussed in the paragraph entitled, "Pavement, Removal and Repair, Flexible".

2. Cracks in the pavement greater than 1/8 in width should be routed to a depth of 1½ inches and width of ½ inch and filled with a mixture of sand emulsion.

3. If the existing asphalt pavement has an extensive crack pattern, consideration should be given to providing reflective crack prevention consisting of a single asphalt treatment or heater scarifying of the existing asphalt pavement. This should be immediately followed by the hot mix asphaltic concrete overlay the same night.

4. As mentioned above, it is not considered necessary to remove rubber deposits from the runway provided the overlay thickness is 2 inches or greater. If it is desired to remove the rubber build-up, the material may be removed by high pressure water jets, chemical, high velocity partical impact or mechanical grinding.

5. Paint markings should be removed from the runway surfaces as the presence of the paint markings could interfere with the bonding of the overlay to the surface. The paint markings may be removed by the same methods as specified for the removal of the rubber build-up.

Selection of Aggregate Gradation

The hot mix asphaltic concrete overlay specifications should provide for only one gradation for the entire depth of the overlay with no intermediate or binder course specified.

The recommended gradation for hot mix asphaltic concrete overlays where aircraft will use the runway within 2 hours after completion of rolling operations is as follows:

Sieve Size	Percentage Passing by Weight
3/4"	100
1/2"	89 ± 7
3/8"	82 ± 7
No. 4	66 ± 7
No. 8	53 ± 7
No. 16	41 ± 7
No. 30	31 ± 7
No. 50	21 ± 6
No. 100	13 ± 5
No. 200	4.5 ± 1.5

Tolerances should be as specified in FAA Specification P-401, "Bituminous Surface Course."

The deletion of the larger sizes of aggregate in the lower courses will prevent any emulsifying of the overlay when placed next to rigid or flexible pavement. Instances have been reported where the binder course using a lower bitumen content has emulsified and contributed to pavement failure.

In most instances where two gradations are specified, it has been found that contractors will bid the same for both the surface course mix and for the intermediate or binder course mixture.

Selection of Asphalt Cement

The selection of the grade of asphalt cement should be predicated on the grade of asphalt cement which is normally specified by the highway departments of the applicable states.

In setting up the specifications for the asphalt cement the exact specifications of the applicable state highway departments should be used.

As a comparison FAA Specification P-401, "Bituminous Surface Course" specifies asphalt cement to be grade 85-100, 120-150 conforming to AASHO specification M-20. In the state of Texas, the bitumen is specified, as in most states, by viscosity grade. For instance, grade 85-100 is classified as AC-10 and grade 120-150 is classified as AC-5. In hot climates, the use of AC-20 with a minimum penetration of 55 should be considered.

This method will secure the most favorable bid price for the asphalt cement and will be readily available. At central hot mix asphalt plants there will not be any complications in regards to the storage of the asphalt cement.

In most instances when other specification of asphalt cement are included in the contract specifications the contractor actually uses the same material as is used by the applicable state highway department specifications.

Selection of Tack Coat

Emulsified asphalt should always be used as a tack coat on the existing rigid or flexible pavement prior to overlay. The emulsified asphalt provides a more uniform coverage than cut-back asphalt which is difficult to apply at low rates of application.

It is important that the emulsified asphalt tack coat also be used between courses of the overlay unless the top course immediately follows the lower course. This is especially true when sandstone aggregate is encountered. Instances have been reported where shoving of the layers has occured when the tack coat was omitted.

Caution should always be exercised to control the amount of emulsified asphalt placed. Normally 0.06 to 0.08 gallon of actual bitumen per square yard will be sufficient.

The designation of the grade of emulsified asphalt used should be the same as specified by the state highway departments in the locality where the overlay construction is to take place. There could be some resistance by contractors to the use of emulsified asphalt since they are used to using cut-back asphalt. One of their objections could be that they do not have the proper storage facilities. In that case, it is considered that the use of emulsified asphalt for tack coat should be mandatory.

Asphalt Plants

Asphalt plants may be the batch, continuous or drum mixer type. For nighttime overlay construction, two asphalt plants should be operated simultaneously. It is preferable that the two plants be located adjacent to each other for ease of plant inspection, however this requirement is not mandatory.

The simultaneous operation of two asphalt plants will afford assurance of continued operation in the event of breakdown of one plant. Storage or surge bins for the hot asphalt mix should be used only on the approval of the project superintendent. Bins should be designed and operated so as to prevent segregation of the mix. If the engineer in charge determines that segregation is occuring, he should prohibit the use of storage or surge bins. Hot asphalt mixtures should be kept in storage or surge bins for no longer than three hours.

Some state highway departments permit the contractor to operate the plant with all plant screens removed with the exception of the scalping screen provided all the other requirements for batch and continuous mixing type plants are met. This method is acceptable provided the aggregates are uniform and the production is within the limits of the specification.

The contractor should make all facilities of the plant available and accessible to the plant inspector.

Hot Mix Asphalt Spreading Equipment and Automatic Grade Control

The hot mix asphalt spreading equipment should be self-powered and propelled spreading machines and should be equipped with automatic screed controls to be used in connection with traveling stringline, erected stringline, or matching shoe. There are several types of traveling stringlines to use in overlay construction and several of these are explained below.

1. Ski - This type from 30' to 45' long lies on the pavement and straightens out depressions better than a wheeled device. The ski requires more mix to straighten out a depression but leaves a more level surface.

2. Wheeled device - This type from 30' to 45' long with two wheels on each and is best for rises. The sensor rides at the midpoint of the stringline thereby sensing the elevation of the front and rear wheels. This system allows a rise to be straightened out and results in a more level surface.

3. Footed frame - This type of traveling stringline consisting of metal feet attached to a metal frame is suitable for both rises and depressions. Each foot moves seperately. The elevation of the grade reference is changed to follow the average reading from all the feet. Therefore, one of the feet could fall into a depression while at the same time another one could be riding over a rise, the average of these high-lows would reflect itself in the grade reference and the mat would be laid accurately. It is important to note that when the sensor is used to sense from a traveling stringline, the stringline is usually as close to the paver as possible.

4. Erected stringline - The erected stringline is most effective where the runway pavement to be overlaid is in very poor condition gradewise. "Very poor condition" means long distances of depressions or rises that it would mean constant adjustments if a traveling stringline is used. The grade reference follower on the erected stringline will either be the grid type or bar type. It is very important that the grade reference follower slide freely on the string. Tack coat on the feeder bar or string may cause some erratic sensing and operation. The joint matcher (6" shoe) should never be used on a stringline. The joint matcher exerts a two-pound reference surface and would cause extreme deflection in the erected stringline.

5. Shoe (Joint Matcher) - A shoe is a short metal grade reference that may be used alone or in conjunction with an erected or traveling stringline. When used in conjunction with one of the other types, the shoe is used to control the grade of the side opposite the stringline. The shoe is the most logical choice for use when the grade reference is another mat. The shoe should always be used to match joints on the final lift of a mat. Under certain circumstances the shoe can be used to match the first and/or intermediate layers of the overlay pavement.

Methods of Automatic Control

The automatic grade control system can be set up to provide grade control in several ways. For multiple lane paving and for nighttime construction, asphalt spreaders, both equipped with automatic grade control devices should be operated in echelon. For the initial lane when a traveling stringline is used the first asphalt spreader should be equipped with sensors on both sides of the machine. After the first asphalt spreader has proceeded about 50 feet, the second paver should proceed using the matching shoe on the previously placed mat and a traveling stringline on the opposite side.

If the erected stringline method is used the first lane to be paved will require the asphalt paver to be equipped with sensors on both sides of the machine. After the first spreader has proceeded about 50 feet, the second paver should proceed as mentioned above and using a matching shoe on the previously placed mat with an erected stringline on the opposite side.

APPENDIX B

QUALITY CONTROL OF CONSTRUCTION

Inspection and Testing of Materials

The construction of hot mix asphaltic concrete pavement at nighttime requires strict inspection construction and testing of materials. Normally on nighttime construction, two hot mix asphalt plants will be specified as well as two hot mix asphalt placing spreads.

The inspection and testing personnel for surveillance of the operation should be as follows:

Engineer in Charge - 1
Asphalt Placing Inspectors - 2
Rolling Inspector - 1
*Plant Inspector - 2

Daily inspection reports should be made by the engineer in charge who is also designated in this study as the airport authority representative. Reports should include location and description of work, results of surveillance and comments on the specifications. Attached to the report should be a summary of the daily laboratory tests listing the following:

Asphalt content	Percent Voids
Stability	Percent Voids Filled with Bitumen
Flow	Aggregate Gradation
Lab Density	Field Density

*If the two hot mix asphalt plants are not located in the immediate area, two plant inspectors should be required at each plant.

The quality control tests should be as follows:

Aggregate stockpile gradation

1. Required mix design preparation and as a check for variations in stockpile gradations.

2. Washed sieve analysis should be taken for each 1,000 tons of aggregate delivered to the job. The contractor should be required to ascertain the suitability of the aggregate before delivering on the job. It should not be the intent of the quality control organization to act as a testing laboratory for the contractor.

Hot bin samples

1. Hot bin gradation tests should be taken for every three days of production.

2. Tests should consist of one dry sieve analysis for each bin sample.

3. Resulting gradation should be paper blended to the feed percentages for use in the gradation unit. The blended mix should be plotted for conformance with the gradation as listed in the paragraph, "Selection of Aggregate Gradation" hereinbefore stated.

Hot mix plant samples

1. Hot mix plant samples should be taken and tested for each 500 tons of production or fraction thereof.

2. Tests should consist of three Marshall specimens and corresponding extraction tests. Reference should be made to truck samples to enable correlation with field density tests after placement.

3. Stability and flow should be determined in accordance with ASTM D 1559 and should meet the following requirements:

No. blows each side - 75
Stability (min) pounds - 1,800
Flow, hundredths of an inch - 8-14
Percent Voids Total Mix - 3-5
Percent Voids Filled With Bitumen - 70-80

4. Extraction tests and sieve analysis should be used to determine bitumen content and aggregate gradation compliance as follows:

Bitumen Content - 4-7%
Aggregate gradation - as specified

5. Density tests

Density tests should be taken for each 500 tons of hot mix asphaltic concrete placement or fraction thereof

Tests should be taken on the section of pavement placed from the truck samples at the plant for stability, flow, etc.

One density sample should be taken on a longitudinal joint

The location of sampling should be randomly selected by the use of random number tables as listed in the Asphalt Institute Manual Series No. 11 (MS-11) of January 1973

Compaction of at least 98% of the density obtained in the laboratory should be required

Temperature tests

Each density sample should be checked and recorded for proper thickness.

1. Each truck should be checked and recorded at the plant for proper mix temperature of 325 degrees F. Plant adjustments should be made to correct for variation.

2. Mixes produced in excess of 350 degrees F should be rejected.

3. Mix temperatures at time of placement in the field should be taken and recorded for each truck

4. Test sections should be run to determine the optimum temperature for proper compaction of the mix. For example, the temperatures used for control of the hot mix asphaltic overlay of the primary runway at the Naval Air Station in Bermuda were as follows:

Breakdown Rolling - 280-290 degrees F
Secondary Rolling - 260-275 degrees F

The above temperatures apply only to the particular project which was located adjacent to the Atlantic Ocean where the hot mix asphaltic pavement would cool rapidly. It is important that a hot joint be maintained at all times and the temperature requirements should be strictly enforced.

Checking Elevations of Completed Mat

Immediately after rolling operations for the night are completed, the contractor's field party should be required to determine the elevations of the completed mat. Elevations should be determined at 25' intervals and 12.5' or 25' transversely depending on the width of the asphalt spreader. These elevations should be reported to the project superintendent so that any adjustments in the 3/16" per inch of rolldown assumption. It is important that these elevations be taken the same night and not at the end of the job. They should be taken for each course so that the contractor will know at all times just how close the asphalt overlay is being placed to plan grade.

Straightedge Requirements

The finished surface of the final course of the hot mix asphaltic concrete overlay should be tested immediately after initial compression. The finished surface should not vary more than 1/4" for the surface course when tested with a 16' straightedge.

The finished surface should be tested by the contractor and witnessed by the airport authority representative in both longitudinal and transverse direction. The contractor should be required to furnish a 16' rolling straightedge for testing purposes.

In the longitudinal direction one path in each lane should be selected for testing. In the transverse direction, random sites should be selected for testing.

Opening Runway to Aircraft Traffic

Prior to opening the runway, the airport authority representative should transport the station manager of the various airlines and they should drive down the runway to see that the transition is in place and that no FOD is on the runway. With the station managers' approval, the airport authority should then advise the FAA control tower operator that the runway should be opened.

It is mandatory that the runway be opened at the designated time without exception. This is important for airlines flight schedules are predicated on opening the runway at designated times. Instances have been reported where the contractor was allowed to continue asphalt placing operations after the target time for opening the runway due to the fact that a parallel runway was available. This should not be permitted as there will be a delay in airline operations which will cause havoc with the flight schedules.

Once the runway is opened to traffic, the only restrictive provision should be that locked wheel U-turns should not be permitted as the turning movement will mark the pavement with track marks.

APPENDIX C

AIRPORT STUDIES

SUMMARY OF NIGHTTIME PAVEMENT CONSTRUCTION PROCEDURES

BALTIMORE-WASHINGTON INTERNATIONAL AIRPORT
BALTIMORE, MARYLAND

1. Airport Manager: R.J. Aaronson - Administrator
State Aviation Administration

2. Facility Overlayed: Runways 10-28, 15-33, 4-22 and associated taxiways. Installed centerline lights on Runway 10-28. Grooved runways 10-28 and 15-33.

   a. Work dates - June to October 1973
   b. A/E - Beavin Company, Baltimore, Maryland

3. Contractor: E. Stewart Mitchell, Inc. of Baltimore, Maryland

   a. Experience of nighttime construction--None on airports; limited experience on highways.

   b. Minority or other--No

4. Plans and Specifications: Available at office of the Director of Engineering.

5. Description of Overlay: Hot mix asphaltic concrete variable depth levelling course, 2" to 3" base course and 1½" to 2½" surface course.

6. Contractor's organization: Project superintendent was on the job at all times and was always available

7. Hours worked, time of year: 12 midnight to 7:00 a.m. (2 intersections for 4 nights of July 25, 26, 29, and 30, 1973) All other work was accomplished in daytime.

8. Owner's inspection of construction: 3 inspectors at plant with 1 inspector in field.

9. Construction planning for overlay-anticipated production: Pre-construction conference held. Close liason with FAA control tower and airlines maintained before construction and daily during construction. Early planning conferences held before and during design stages.

10. Equipment:

a. Lighting - Owner furnished mobile lighting (2 units); four 1,000 watt mercury vapor lights - 30" high on each unit

b. Laydown machine - 25' wide asphalt asphalt spreader. Spreader was equipped with automatic control devices.

c. Plants - Contractor used two batch plants; one at Severen and one at Mitchellville, Maryland.

d. Grade control - Polyethylene braided line under tension set on pins with steel plates set 50' apart with intermediate supports. Automatic sensors on 25' wide asphaltic spreaders.

e. Rollers - Breakdown rolling with medium sized vibrating roller. Intermediate and final rolling performed with large dual drum roller. Light rubber-tired roller used to seal surface.

11. Quality control: Asphalt Mix Requirements:

a. Mix design - 3/4" maximum size aggregate used for base and surface

b. Gradations -

3/4"	100
1/2"	82-96
3/8"	75-90
No. 4	60-73
No. 10	43-57
No. 20	29-43
No. 40	19-33
No. 80	10-20
No. 200	3-6

c. Extraction - Asphalt cement - 5.25%
2 extraction tests per day
Marshall stability pats - 3 sets per night

d. Stabilities - 1800-2500 Flow 8-16

e. Density - 98% plus laboratory density of same mixture

f. Voids - 3-5

g. Voids filled - 70-80

h. Field density - 98% plus density obtained by nuclear testing

12. Grade control requirements:

a. Ski - Used 50' ski for surface course only on both sides of asphalt spreader for initial lane. Others-ski and matching shoe.

b. Level party check elevations after each course - Yes

c. Straightedge - Surface course only. 10' long straightedge with a variation not to exceed 1/8".

13. Lighting fixtures (Adjustments):

a. Centerline lights - New for full length runway (see comments)

b. Edge lights - Left in place

14. Surface preparation prior to overlay:

a. Rubber removed - No

b. Paint removed - No. Highly recommended no paint and rubber removal. No problems were encountered by not doing this.

c. Joint cleaning and filling with sand emulsion mixture - No

d. Excess sealer removal - None

e. "D" line cracking repair - None

f. Spall repair - None

g. Slab removals and replacements - None

h. Other (mudjacking, asphalt underseal) - None

i. Heater scarifying - None

15. Temporary transition (at end of night's work):

a. Length - 2% slope

b. Time for removal next night - 30 minutes maximum

c. Procedure for removal - Blade grade with scarifier. A thin layer of sand was used under transition for easy removal. the last 18" transition had tack coat applied.

d. Slip joint used - No

e. Transition mix - Surface course P-401 mix was used for all paving including transitions

16. Climactic conditions:

a. Temperature - 50 degrees to 70 degrees F.

b. Wind - Variable

c. Rainfall - Usual

17. Shoulder construction:

a. Type - Earth shoulder were deleted and hot mix asphaltic concrete shoulders were substituted

b. Width - variable

c. Construction along with overlay - After completion of overlay

d. Mix design - FAA Specification P-401, maximum 3/4" surface course mix used for all courses

18. Grooving of Asphalt:

a. Typical section of groove - 1/4" by 1/4" by 1½" centers. Contractor used wet method of sawing to keep down dust.

b. How long after overlay was grooving initiated?- Within 15 days

c. Test sections - 100' test section - 20' wide

d. Any plastic flow of grooving?- None

e. General acceptability of grooving - Grooving was performed satisfactorily three years later

19. Miscellaneous Comments: Airport authorities received very favorable comments from the Airlines and from the FAA Control Tower Chief. The job was very successful, however, the night work was for intersections only (4 nights). The first operation on Runway 10-28 was to install conduit and base and electrical connections in the runway pavement. A 6" X 6" trench was cut longitudinally along the centerline of the runway and transversely where required. An 18" core X 12" deep was then removed from the pavement on 50' centers, conduit was then put in the trench and a 12" by 12" base box put in the cored hole. Concrete was then placed in the void area and was brought up flush with the old surface. The bases were set by instrument so they could be located after overlay was placed. The new centerline lights were installed by coring out directly over the previously placed base boxes and filling the lights in place flush with the new surface. Epoxy sealing compound was used to fill in the area between the lights and the new overlay. All placing of conduit and lights was performed at night.

SUMMARY OF NIGHTTIME PAVEMENT CONSTRUCTION PROCEDURES

GREATER BUFFALO INTERNATIONAL AIRPORT
BUFFALO, NEW YORK

1. Airport Manager: Richard Rebadow, General Manager
   Niagara Frontier Transportation Authority

2. Facility Overlayed: Construction of Rehabilitation of Runway 5-23 and connecting taxiway. Lighting on Runway 5-23.

   a. Work dates - Stage #1 - May 1975 to November 1975
   b. A/E - Howard, Needles, Tammen, & Bergendoff of Buffalo, New York

3. Contractor: Tri-Delta Construction Corporation of Buffalo, New York

   a. Experience on nighttime construction - No previous experience. Work was satisfactory after shakedown operations. Contractor was well-prepared to perform the work.

   b. Minority or other - No

4. Plans and Specifications: Available in Consulting Engineers' office

5. Description of Overlay: 2" to 17" hot mix asphaltic concrete. The overlay varied from center point crown to third point crown.

6. Contractor's Organization: Project manager on job at all times. Was an officer of the company.

7. Hours worked, time of year: 11:00 p.m. to 6:00 a.m. for six days a week. Crew soon tired of working these periods.

8. Owner's inspection of construction: Howard, Needles, Tammen, and Bergendoff provided inspection and laboratory testing of the project.

9. Construction planning for overlay-anticipated production: Pre-bid conference attended by all bidders. Pre-construction conference to determine contractor's schedule. There were day to day agreements on the work schedules.

10. Equipment:

a. Lighting - All paving machines, rollers and distributors equipped with lights, in addition to 12 mobile lights

b. Laydown machine - 25' wide asphalt paver

c. Plants - batch plant

d. Grade control (type, personnel) - On levelling course set erected stringline with pins set every 25 ft.

e. Rollers - Tampo vibrating rollers and heavy pneumatic roller

11. Quality control: Asphalt Mix Requirements:

a. Mix design - FAA P-401 modified by Addendum

b. Gradations -

1"	100
3/4"	86-100
1/2"	74-88
3/8"	66-80
No. 4	54-68
No. 10	39-47
No. 40	19-27
No. 80	8-16
No. 200	3-7

Mixing Temperature - 285 degrees F.
Mixing Temperature Range - 270 to 300 degrees F
Asphalt Grade - AC-10
Asphalt Cement - 5.0

c. Extraction - Two extraction tests per day
Three Marshall density tests per day

d. Stabilities - 1800+

e. Density - 98% of laboratory density of same mixture

f. Voids - 3-5

g. Voids filled - 70-80

h. Field density - Around 98% of laboratory density

12. Grade control requirements:

a. Ski - On all courses except levelling course

b. Erected stringline - On levelling course only

c. Level party check elevations after each course - Yes

d. Straightedge - Will be performed under final Stage II

e. Final grades - No. Stage II will construct overlay to final grades.

13. Lighting fixtures (Adjustments):

a. Centerline lights - Provided new centerline and touchdown zone lights

b. Edge lights - Replaced existing edge lights

14. Surface preparation prior to overlay:

a. Rubber removal - Removed by water jet. There was some question whether this was necessary.

b. Paint removal - Sand-blasted. Water jet would not satisfactorily remove paint.

c. Joint cleaning and filling with sand emulsion mixture - No

d. Excess sealer removal - Removed a very limited amount

e. D-line cracking repair (type) - No

f. Spall repair (type) - Very limited

g. Slab removals and replacements - None on runway

h. Other (mudjacking, asphalt underseal) - None

i. Heater scarifying - None

15. Temporary transition (at end of night's work):

a. Length - The transition was constructed with 20:1 slope and was built by lowering the screed for the required length

b. Time for removal next night - Approximately 1 hour

c. Procedure for removal - Blade grader and front end loader

d. Slip joint used - No

e. Transition mix - Used regular surface course mix for constructing transition

17. Climactic conditions:

a. Temperature - 75 - 90 degrees F

b. Wind - Variable

c. Rainfall - Usual

18. Shoulder Construction:

a. Type - 2" Hot Mix Asphaltic Concrete
6" to 24" tapered flexible base

b. Width - 25'

c. Constructed along with overlay - constructed after overlay was finished

d. Mix design - FAA Specification P-401

19. Grooving of Asphalt:

a. Typical section of groove - No

b. How long after overlay was grooving initiated - N/A

c. Test sections - N/A

d. Any plastic flow of grooving - N/A

e. General acceptability of grooving - N/A

20. Miscellaneous Comments:

The Airport Authority received favorable comments from pilots on the smoothness of the overlay.

SUMMARY OF NIGHTTIME PAVEMENT CONSTRUCTION PROCEDURES

DALLAS LOVE FIELD
DALLAS, TEXAS

1. Airport Manager: Howard Megredy

2. Facility Overlayed: Runway 13L-31R (7,750 X 150 ft.)

   a. Work dates - November 1, 1969 to January 29, 1970
   b. A/E - Forrest & Cotton, Inc. of Dallas, Texas

3. Contractor: H. B. Zachary Company of San Antonio, Texas

   a. Experience on nighttime construction - None
   b. Minority or other - No, but Contractor used primarily Mexican-American personnel who were excellent workers

4. Plans and Specifications: Available in the office of the Director of Airports, Dallas Love Field, Dallas, Texas

5. Description of overlay: Approximately 17" overlay with hot mix asphaltic concrete for length of runway. Had to build up overruns with the same type material.

6. Contractor's organization: Contractor had good organization which was very experienced in placing the hot mix asphaltic concrete overlay. Project superintendent was very capable.

7. Hours worked, time of year: 10:00 p.m. to 7:00 a.m. six days a week

8. Owner's inspection of construction (plant, lab, laydown): Forrest and Cotton, Inc. inspected the overlay work. National Soil Services provided laboratory control. Testing laboratories had field laboratory set up at batch plant.

9. Construction planning for overlay-anticipated production: Pre-construction conference. Daily conferences concerning the work.

10. Equipment:

a. Lighting - Provided 4-1,000 watt mercury vapor lighting units as needed

b. Laydown machine - 25' wide asphalt spreader for hot mix asphaltic concrete base and 12.5' spreader for hot mix asphaltic concrete surface course

c. Plants - Two batch plants

d. Grade control (type, personnel) - Used blade grader for levelling course, set erected stringline for intermediate courses and for surface course. Runway was closed for placing of the levelling course

e. Rollers - Contractor used vibrating roller for compaction. Made some use of pneumatic tired roller

11. Quality control: Asphalt Mix Requirements:

a. Mix design - FAA P-201 FAA P-401

b. Gradations -

FAA P-201		FAA P-401	
1½"	100	1"	100
1"	86-100	3/4"	82-100
3/4"	68-92	1/2"	70-90
1/2"	55-84	3/8"	60-82
3/8"	46-76	No. 4	42-70
No. 4	32-64	No. 10	30-60
No. 10	20-50	No. 40	15-40
No. 40	8-30	No. 80	8-26
No. 80	4-19	No. 200	3-8
No. 200	3-8		

c. Extraction - Marshall tests as per ASTM D 1559

d. Stabilities - 1800+

e. Density - 98% of laboratory density of same mixture

f. Voids - P-201--3-8 P-401--3-5

g. Voids filled - P-201--60-70 P-401--70-80

h. Field density - Around 98% density

12. Grade control requirements:

a. Ski - No

b. Erected stringline - set erected stringline

c. Level party check elevations after each course - Yes

d. Straightedge - Yes

e. Final grades - determined by consulting engineer

13. Lighting fixtures (adjustments):

a. Centerline lights - provided new centerline lights

b. Edge lights - Raised elevation of edge lights

14. Surface preparation prior to overlay:

a. Rubber removal - None

b. Paint removal - None

c. Joint cleaning and filling with sand emulsion mixture - None

d. D-line cracking repair (type) - N/A

e. Spall repair (type) - N/A

f. Excess sealer removal - N/A

g. Slab removals & replacements - N/A

h. Other (mudjacking, asphalt underseal) - None

i. Heater scarifying - None

15. Temporary transition (at end of night's work):

a. Length - Approximately 20 ft.

b. Time for removal next night - 30 minutes

c. Procedure for removal - Blade grader and front end loader

d. Slip joint used - No

e. Transition mix - used same mix as used for the overlay that particular night

16. Climactic conditions:

a. Temperature - 40 degrees to 82 degrees

b. Wind - Variable

c. Rainfall - Usual

17. Shoulder Construction:

a. Type - Earth

b. Width - Variable

c. Constructed along with overlay - Yes

d. Mix design - N/A

18. Grooving of Asphalt:

a. Typical section of groove - ¼" by ¼" by 1½" center to center

b. How long after overlay was grooving initiated? - Contractor started work on November 12, 1970 and completed work on December 31, 1970.

c. Test sections - None

d. Any plastic flow of grooving - Some plastic flow at taxiway entrances to runway

e. General acceptability of grooving - Airport director was pleased with the grooving operations after being interviewed in November, 1976

19. Miscellaneous Comments: There was some plastic flow of the grooving at taxiway connections to the runway. Runway overlay involved approximately 140,266 tons of hot mix asphaltic concrete base and approximately 41,764 tons of hot mix asphaltic concrete surface course. The parallel runway 13L-31R was closed from Nov. 1 to Nov. 5, 1969 to allow for the daytime placing of the levelling course which varied from 2 to 9 inches. The runway was also closed for 5 days at end of project to allow for placing of the surface course. Contractor placed approximate 3" to 3 3/4" of intermediate course (P-201) per night. Contractor performed the grooving operations at night from 10:30 p.m. to 6:00 a.m. Grooving quantity was 975,350 S.F. at 0.07225 per square foot. Width of grooved areas was 130' leaving 10' on each side of the runway for passage of equipment.

SUMMARY OF NIGHTTIME PAVEMENT CONSTRUCTION PROCEDURES

ADAMS FIELD
LITTLE ROCK, ARKANSAS

1. Airport Manager: R. M. Crisp, Sr.

2. Facility Overlayed: Runway 4-22 Strengthened and Related Electrical Work - FAA Project 9-03-01719

   a. Work dates - August 22 to October 30, 1968
   b. A/E - Garver and Garver, Inc. of Little Rock (Prin. Roy Grimes)

3. Contractor: Ben Hogan of Little Rock

   a. Experience on nighttime construction - None
   b. Minority or other - No

4. Plans and Specifications: Furnished by Garver & Garver, Consulting Engineers for the City of Little Rock

5. Description of overlay (runway, etc): 2" levelling course in critical areas, 6" to 7" total overlay thickness, center 100' 1.33% transverse slope, outside 25' 1.67% transverse slope

6. Contractor's organization: Project superintendent full time. Contractor had good organization.

7. Hours worked, time of year: 11:00 p.m. to 6:00 a.m. seven days a week. Contractor later changed to six days to eliminate working on Saturday night.

8. Owner's supervision of construction (plant, lab, laydown): Garver and Garver, Inc. Consulting Engineers inspected the project. Full-time inspection was provided. Project Engineer for the A/E made on-the-spot decisions as to the extent of repair areas. Visual inspection was made on overlay each morning prior to opening to aircraft traffic. Norve-1-Plowman Laboratories, Inc. provided testing services.

9. Construction planning for overlay-anticipated production: Daily meeting set up at 4:00 p.m. to discuss nighttime operations.

10. Equipment:

a. Lighting - Lights provided on all rollers and asphalt spreader. Contractor utilized two mobile lighting units.

b. Laydown machine - 12.5' wide asphalt spreader with electronic control

c. Plants - Batch type plant

d. Grade control (type, personnel) - Used field party to set erected stringline for levelling course. Used 30' ski and matching shoe on other courses.

e. Rollers - Used tandem roller for breakdown rolling. Heavy duty pneumatic rollers used for breakdown and tandem roller used for final rolling.

11. Quality control: Asphalt Mix Requirements:

a. Mix Design - P-401 Bituminous Surface Course

b. Gradations -

Type B		Type C	
3/4"	100	1/2"	100
1/2"	82-100	3/8"	82-100
3/8"	68-90	No. 4	56-88
No. 4	50-79	No. 10	40-75
No. 10	36-67	No. 40	19-48
No. 40	17-44	No. 80	10-32
No. 80	9-29	No. 200	4-9
No. 200	3-8		

c. Extraction - Tests-Marshall stability tests according to ASTM D 1559

d. Stabilities - 1800 Min. Flow 8-16

e. Density - 98% of laboratory density of same mixture

f. Voids - 3-5

g. Voids filled - 75-85

h. Field density - Averaged around 98%

12. Grade control requirements:

a. Ski - Used on all but levelling courses

b. Erected stringline - Used erected stringline on levelling courses

c. Level party check elevations after each course - Checked elevation of levelling course

d. Straightedge - 16' straightedge with 1/4" deviation

e. Final grades - Check final grades only at intersection on 25' centers

13. Lighting fixtures (Adjustments):

a. Centerline lights - None

b. Edge lights - Adjusted later under another contractor

14. Surface preparation prior to overlay:

a. Rubber removal - None, Consulting Engineer did not recommend removal of rubber

b. Paint removal - None

c. Joint cleaning and filling with sand emulsion mixture, etc.- Some cleaned and filled with sand asphalt mixture

d. Excess sealer removal - None

e. D-line cracking repair (type) - None

f. Spall repair - None

g. Slab removals and replacements - Replaced failed asphalt with hot mix asphalt concrete base in 3 lifts (1st lift - 6" comp) (other lifts were 2-3 inch comp. lifts. Special gradation used. (See comments)

h. Other (mudjacking, asphalt underseal) - None

i. Scarifying - None

15. Temporary transition (at end of night's work):

a. Length - 12.5' long made with transverse pass of asphalt spreader

b. Time for removal next night - Not removed

c. Procedure for removal - Transition left in place

d. Slip joint used - Yes

e. Transition mix - No special mix used. Used same mix as surface course. Large aggregate raked out of feather edges.

16. Climactic conditions:

a. Temperature - 42 degrees - 86 degrees

b. Wind - Variable

c. Rainfall - Usual

17. Shoulder Construction:

a. Type - None

b. Width - N/A

c. Constructed along with overlay - N/A

d. Mix design - N/A

18. Grooving of Asphalt:

a. Typical section of groove - None

b. How long after overlay was grooving initiated - N/A

c. Test sections - N/A

d. Any plastic flow of grooving - N/A

e. General acceptability of grooving - N/A

19. Miscellaneous Comments: Contractor was paid by the day for suspension time; in the event the night's work was suspended after reporting for work. The contractor's bid price on this item was $100 which appears to be a token bid. Standby time was also included in the contractors bid which was bid at $75 per hour. Consulting Engineers pleased with overlay construction by Ben Hogan, Contractor. Estimated nighttime construction was approximately 10% more than daytime work.

Gradation for the hot mix asphaltic concrete for the pavement repair areas:

Asphalt Penetration	85 - 100
Asphalt Content	3% - 5%

Aggregate

Total Retained on 1½" sieve - 0%
Total Retained on 3/4" sieve - 10% to 50%
Total Retained on No. 4 sieve - 50% to 75%
Passing No. 40 sieve - 10% to 30%
Passing No. 200 sieve - 3% to 10%

SUMMARY OF NIGHTTIME PAVEMENT CONSTRUCTION PROCEDURES

NORFOLK INTERNATIONAL AIRPORT
NORFOLK, VIRGINIA

1. Airport Manager: C. P. Mangum, Jr.

2. Facility Overlayed: Runway 5-23 and Parallel Taxiway

   a. Work dates - August 15 to October 15, 1972
   b. A/E - Burke Associates of Parkridge, Illinois

3. Contractor: Birsch Construction Company of Norfolk, Virginia

   a. Experience on nighttime construction - None
   b. Minority or other - No

4. Plans and Specifications: Available at airport manager's office

5. Description of overlay (runway, etc): 2" to 3" levelling course and 2" surface course.

6. Contractor's organization: Project superintendent and complete paving crew. It was reported that the paving crew was not favorable to nighttime work.

7. Hours worked, time of year: 11:00 p.m. to 7:00 a.m. for six nights a week

8. Owner's inspection of construction: Quality control by Law Engineering Company employed by Airport Authority. Inspectors in field and at plant. Testing laboratory set up at plant.

9. Construction planning for overlay-anticipated production: Pre-design and pre-construction meetings with owner, A/E, airlines and FAA control tower personnel.

10. Equipment:

    a. Lighting - All moving machinery equipped with lights.

    b. Laydown machine - 12.5' wide asphalt spreader

    c. Plants - 1 plant

d. Grade control - Level party set grades. Electronics grade control with ski. Contractor having difficult time maintaining grade due to variable crown slope.

e. Rollers - Static rollers used. Vibratory rollers used were not satisfactory for this particular project.

11. Quality Control: Asphaltic Mix Requirements:

a. Mix design - P-201 Base Couse P-401 Surface Course

Gradations

1½"	100	3/4"	84-100
1"	75-95	1/2"	74-88
3/4"	68-87	3/8"	68-82
1/2"	59-77	No. 4	54-67
3/8"	53-70	No. 10	38-51
No. 4	39-55	No. 40	17-30
No. 10	27-42	No. 80	9-19
No. 20	17-30	No. 200	3-6
No. 40	13-23		
No. 80	7-15		
No. 200	3-7		

b. Tests - Marshall stability, extractions, gradation, % asphalt and density tests were required twice daily during construction. At times, 3 or more tests were made in a single night.

c. Stabilities - 1800+

d. Density - 98% of laboratory density

e. Voids - 5-7 (Item P-201) and 3-5 (Item P-401)

f. Voids filled - 50-70 (P-201) and 70-80 (P-401)

g. Field density - Field density secured averaged around 98%

12. Grade control requirements:

a. Ski - All layers

b. Erected stringline - No

c. Level party check elevations after each course - Yes

d. Straightedge - 16" straightedge (1/4" deviation)

e. Final grades - Contractor ran levels on final grades. Difficult to construct due to variable slopes.

13. Lighting fixtures (adjustments):

a. Centerline lights - None

b. Edge lights - No. Adjusted threshhold lights.

14. Surface preparation prior to overlay:

a. Rubber removal - None

b. Paint removal - None

c. Joint cleaning and filling with sand emulsion mixture, etc. - Minor crack sealing

d. Excess sealer removal - None

e. D-line cracking repair (type) - None

f. Spall repair (type) - None

g. Other (mudjacking, asphalt underseal) - None

h. Slab removals and replacements - None

i. Heater scarifying - None

15. Temporary transition (at end of night's work):

a. Length - Transition built on 0.50% grade. Approximate distance 25 feet to 35 feet.

b. Time for removal next night - Between one and two hours

c. Procedure for removal - Blade

d. Slip joint used - No

e. Transition mix - Used the same mix as was used for overlay

16. Climactic conditions: Temperatures were 60 to 80 degrees F.

17. Shoulder construction:

    a. Type - Earth

    b. Width - varied

    c. Constructed along with overlay - No.

    d. Mix design - N/A

18. Grooving of asphalt:

    a. Typical section of groove - None

    b. How long after overlay was grooving initiated - N/A

    c. Test sections - N/A

    d. Any plastic flow of grooving - N/A

    e. General acceptability of grooving - N/A

19. Miscellaneous Comments: Contractor had difficulty in placing the asphaltic concrete base course due to warped grades and variable thickness. Special mix was not used for thin sections. Variable crown slopes were designed to save money on hot mix asphaltic concrete, however, this created construction problems for the Contractor. Used two mobile with 12 flood lights. This was unsatisfactory and was increased to 17 flood lights due to resurfacing runs of 1,000 feet. There appeared to be no clear cut authority in the field to make decisions for the Airport Authority. Need one man to control the project with the ability to make ready decisions and make them stick. Contractor started out using P-201 Asphalt Base Course for levelling after he had difficulty in laydown due to large aggregate in thin layers. P-401 Asphalt Surface Course was used thereafter.

SUMMARY OF NIGHTTIME PAVEMENT CONSTRUCTION PROCEDURES

SHREVEPORT MUNICIPAL AIRPORT
SHREVEPORT, LOUISIANA

1. Airport Manager: John A. Alford, Director of Airports

2. Facility Overlayed: Runway 13-31 (7300' X 200')

   a. Work dates - Sept. 24, 1972 to April 1973
   b. A/E - Aillet Fenner, Jolly & McClelland, Inc.
      Shreveport, Louisiana

3. Contractor: Ray Cook & Sons, Bossier City, Louisiana

   a. Experience on nighttime construction - Contractor had no previous experience

   b. Minority or other - No

4. Plans and Specifications: Available at the engineer's office

5. Description of overlay: 6" hot mix asphaltic concrete overlay with 1% transverse slope except 24'-9" outside lanes which were 1.5% transverse slope. Overlay placed in 3 lifts (1½" to 2" top lift)

6. Contractor's organization: Project superintendent on job was Willard Cook, one of the owners. Contractor was well organized.

7. Hours worked, time of year: 1:00 a.m. to 6:00 a.m. - Monday through Friday

8. Owner's inspection of construction (plant, lab, laydown): Aillet, Fenner, Jolly, & McClelland, Consulting Engineers inspected construction. Barrow-Agee provided testing services. Organization consisted of one project inspector and one laboratory man. Principal from Consulting Engineers was on job at start of work and made periodic visits during construction.

9. Construction planning for overlay-anticipated production: Pre-bid conference and pre-construction conferenc

10. Equipment:

    a. Lighting - Lights on equipment, portable lights used. 4 - 1,000 watt lights per unit.

    b. Laydown machine - 12.5' wide asphalt spreader

    c. Plants - batch plant

    d. Grade control (type, personnel) - Consulting engineer furnished 4 man field party. Set grades in daytime.

    e. Rollers - Breakdown rolling done with vibrating roller, also used pneumatic roller. Used tandem roller for final finishing.

11. Quality Control: Asphalt Mix Requirements:

    a. Mix design - P-401 Bituminous Surface Course

    b. Gradations - Type B

3/4"	100
1/2"	82-100
3/8"	68-90
No. 4	50-79
No. 10	36-67
No. 40	17-44
No. 80	9-29
No. 200	3-8

    c. Extraction - Marshall stability tests according to ASTM D 1559

    d. Stabilities - 1800 Min. Flow - 8-16

    e. Density - 98% of laboratory density of same mixture

    f. Voids - 3-5

    g. Voids filled - 75-85

    h. Field density - averaged approximately 98%

12. Grade control requirements:

a. Ski - None

b. Erected stringline - erected on supports spaced on 25' centers

c. Level party check elevations after course - checked each course, A/E set grades

d. Straightedge - No

e. Final grades - "As built" grades determined by rod & level survey

13. Lighting fixtures (adjustments):

a. Centerline lights - None

b. Edge lights - Adjusted to new elevation

14. Surface preparation prior to overlay:

a. Rubber removal - None

b. Paint removal - None

c. Joint cleaning and filling with sand emulsion mixture - None

d. Excess sealer removal - Excess sealing material was removed

e. D-line cracking repair (type) - None

f. Spall repair (type) - None

g. Slab removals & replacements - 21-12.5' by 15' old 8" P.C.C. slabs removed including 4" of base and replaced with 12" of hot mix asphaltic concrete. No subgrade compaction.

h. Other (mudjacking, asphalt underseal) - None

i. Heater scarifying - None

15. Temporary transition (at end of night's work):

a. Length - Contractor ran transversely 12.5' wide. There were complaints from pilots on some of the transitions being rough. However, an inspection made in May 1976 indicated that the transitions left in place had bonded to the underlying asphalt and there was no apparent difference in the mat.

b. Time for removal next night - Approximately 1 hour after starting of removing, the transition procedure was changed to leave transition in place

c. Procedure for removal - Transition was first removed by blade grader and front end loader

d. Slip joint used - Yes, slip joint is defined as leaving the transition in place

e. Transition mix - Used same mix as used for surface course. Raked out and disposed of larger aggregate

16. Climactic conditions:

a. Temperature - 60 degrees to 92 degrees

b. Wind - Variable

c. Rainfall - Usual

17. Shoulder construction:

a. Type - None

b. Width - N/A

c. Constructed along with overlay - N/A

18. Grooving of asphalt:

a. Typical section of groove - None

b. How long after overlay was grooving initiated? - N/A

c. Test sections - N/A

d. Any plastic flow of grooving - N/A

e. General acceptability of grooving - N/A

19. Miscellaneous Comments: Experience of the Shreveport Airport indicates that overlay operations can be accomplished at night. The overlay work at nighttime requires a dependable contractor interested in performing a good job. The nighttime working time for this project was too short as more time was needed to reduce the number of transverse joints. Contractor placed about 400' per night.

SUMMARY OF NIGHTTIME PAVEMENT CONSTRUCTION PROCEDURES

WASHINGTON NATIONAL AIRPORT
WASHINGTON, D.C.

1. Airport Manager: Frank Conlon

2. Facility Overlayed: Runway 18-36, centerline lighting, pavement grooving and marking

   a. Work dates - August 31, 1972 to January 10, 1973
   b. A/E - Howard, Needles, Tammen & Bergendoff of Arlington, Virginia

3. Contractor: Burno Construction Associates, Inc. of Washington, D.C.

   a. Experience on nighttime construction - None
   b. *Minority or other - No*

4. Plans and specifications: Available at office of Washington National Airport Engineering Branch AMA-121

5. Description of overlay(runway, etc): 5" to 9" overlay of existing runway. Runway 18-36 - Top 1½" - P-401. Modified levelling course and intermediate course. Item P-201. Runway slope increased to 1.5%.

6. Contractor's organization: Batch plant and asphalt placing spread.

7. Hours worked, time of year: 11:00 p.m. to 7:00 a.m.

8. Owner's inspection of construction (plant, laydown, lab): Howard, Needles, Tammen, & Bergendoff provided inspection of the project. Froehling & Robertson, Inc. provided laboratory control General inspection included observation of batching, truck weighing, temperature of aggregate, temperature of liquid asphalt, and appearance of the completec mix.

9. Construction planning for overlay-anticipated production: Pre-construction conference. Daily meeting to discuss the work.

10. Equipment:

a. Lighting - Mobile lighting units

b. Laydown machine - 12.5' asphalt spreader

c. Plants - batch plant

d. Grade control (type) - field party set erected stringline

e. Rollers - vibrating and pneumatic tired rollers

11. Quality control: Asphalt Mix Requirements:

a. Mix design - FAA P-201 and P-401, Modified

b. Gradations -

Bituminous Base (P-201)		Bituminous Surface (P-401)	
1½"	100	1"	100
3/4"	73-85	3/4"	95-100
1/2"	60-72	3/8"	63-77
3/8"	53-63	No. 4	43-57
No. 4	38-48	No. 8	31-30
No. 8	28-35	No. 50	6-14
No. 200	2-6	No. 200	2-6

c. Extraction - The frequency of testing was as follows:

Gradation and asphalt content - 2 or 3 times per day
Temperature of completed mix - Each truck
Marshall density - 2 or 3 times per day

d. Stabilities - Not less than 2,000. Flow not to exceed 11.

e. Densities - 98% of laboratory density of same mixture

f. Voids - Base 3-8
Surface 3-5

g. Voids filled - Base 60-70
Surface 70-80

h. Field density - Density around 98%

12. Grade control requirements:

a. Ski - Used ski for surface

b. Erected stringline - set erected stringline for levelling course and for intermediate courses

c. Level party check elevations after each course - Yes

d. Straightedge - 16' rolling straightedge furnished by FAA

e. Final grades - Indicated pavement in several places was placed several inches off grade. Some areas too high and some places too low

13. Lighting fixtures (adjustments):

a. Centerline lights - New centerline lights installed

b. Edge lights - New touchdown zone lights installed. Material used to backfill trench for conduit was found to be unsatisfactory

14. Surface preparation prior to overlay:

a. Rubber removal - No

b. Paint removal - No

c. Joint cleaning and filling with sand emulsion mixture - No

d. Excess sealer removal - N/A

e. D-line cracking repair (type) - N/A

f. Spall repair (type) - N/A

g. Slab removals and replacements - N/A

h. Other (mudjacking, asphalt underseal) - Heater planed certain areas to match existing runway (approx. 10,530 sq. yds.)

i. Heater scarifying - N/A

15. Temporary transition (at end of night's work):

a. Length - 10' for every 1½" of differential depth

b. Time for removal next night - 2 hours

c. Procedure for removal - Front end loader and blade grader

d. Slip joint used - No

e. Transition mix - Used same mix as for the particular course being placed

16. Climactic conditions:

a. Temperature - 32 degrees to 93 degrees

b. Wind - Variable

c. Rainfall - Usual

17. Shoulder construction:

a. Type - Hot mix asphaltic concrete base course

b. Width - 25' wide and 1½" composition thickness constructed on 5% slope

c. Constructed along with overlay - Yes

d. Mix design - FAA P-401

18. Grooving of Asphalt:

a. Typical section of groove - groove width 1/4", groove depth 1/4", and center to center spacing is 1½"

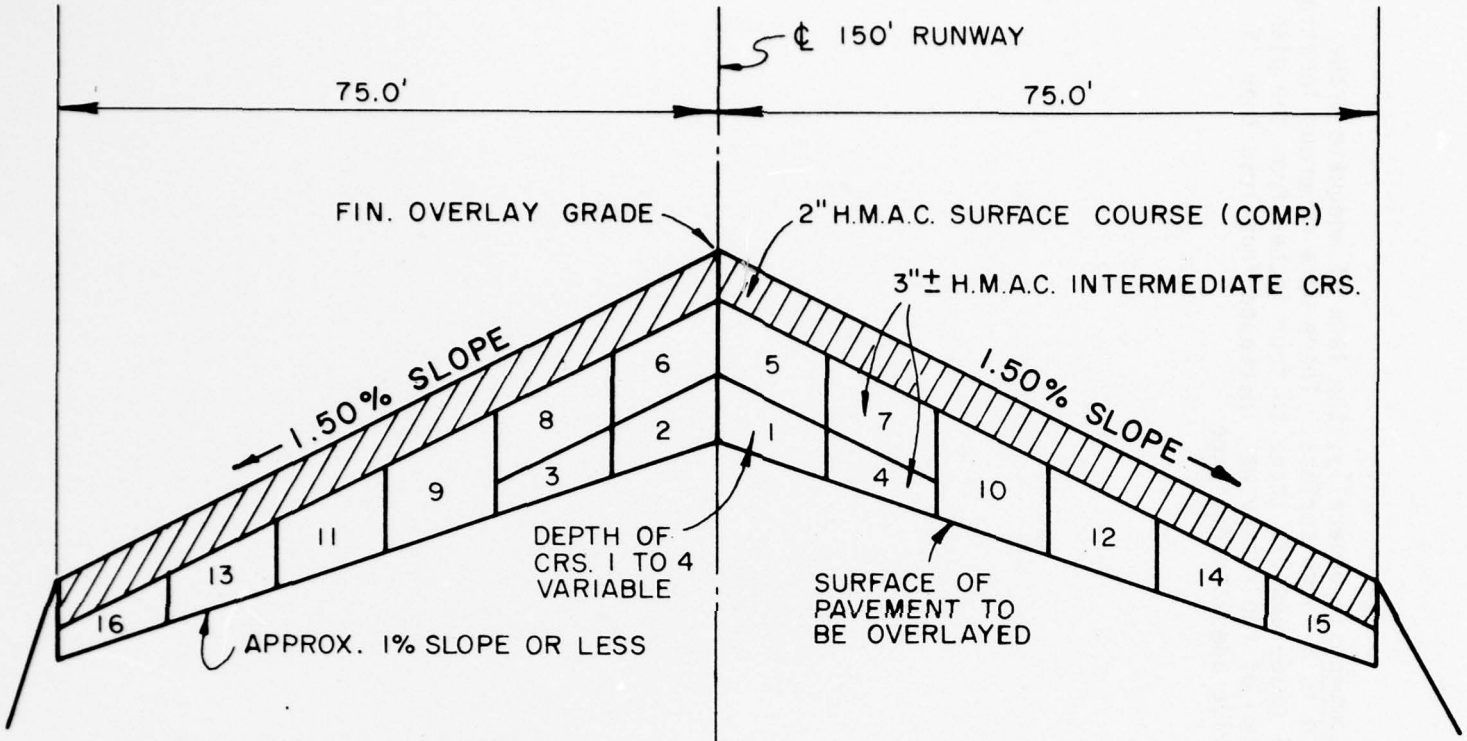
b. How long after overlay was grooving initiated? - Surface course was allowed to cure for 12 hours minimum

c. Test sections - Contractor completed test section prior to initiation of grooving

d. Any plastic flow of grooving? - Some plastic flow occurred at certain locations

e. General acceptability of grooving - Grooving was not satisfactory in certain areas

19. Miscellaneous Comments: Generally, the lack of adequate grade control resulted in a rough surface. There were numerous locations where the final grade was off three to four inches from the plan grade. The crown of the runway was increased from less than 1% to 1.5% to provide adequate drainage.

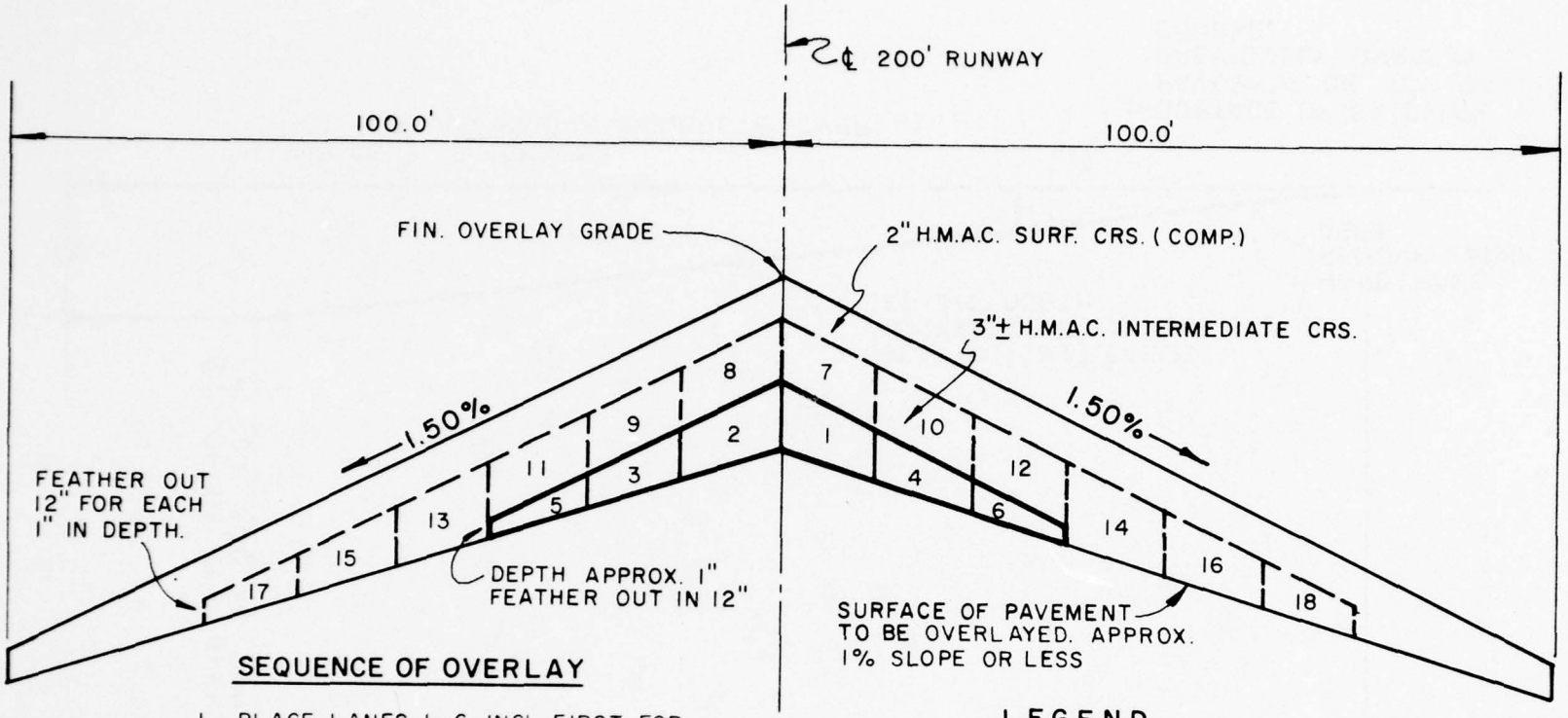


NOTE: ALL COURSES TO BE CONSTRUCTED OF SAME GRADATION – 3/4" MAT. SIZED AGGREGATE OVERLAY ENTIRE WIDTH RUNWAY – APPROX. 800 LGTH.

LEGEND

[1] SEQUENCE OF LANE PLACING (BASED ON 12.5' WIDTH)

FIGURE 1 – TYPICAL OVERLAY SECTION (150' RUNWAY)
(NOT TO SCALE)



SEQUENCE OF OVERLAY

1 PLACE LANES 1–6 INCL. FIRST FOR ENTIRE LENGTH RWY. (800 MIN. PLACING.)

2 PLACE LANES 7–18 SECONDLY SAME DISTANCE AS SPECIFIED ABOVE.

LEGEND

[1] SEQUENCE OF LANE PLACING (BASED ON 12.5' WIDTH)

FIGURE 2 – TYPICAL OVERLAY SECTION (200' RUNWAY)
(NOT TO SCALE)

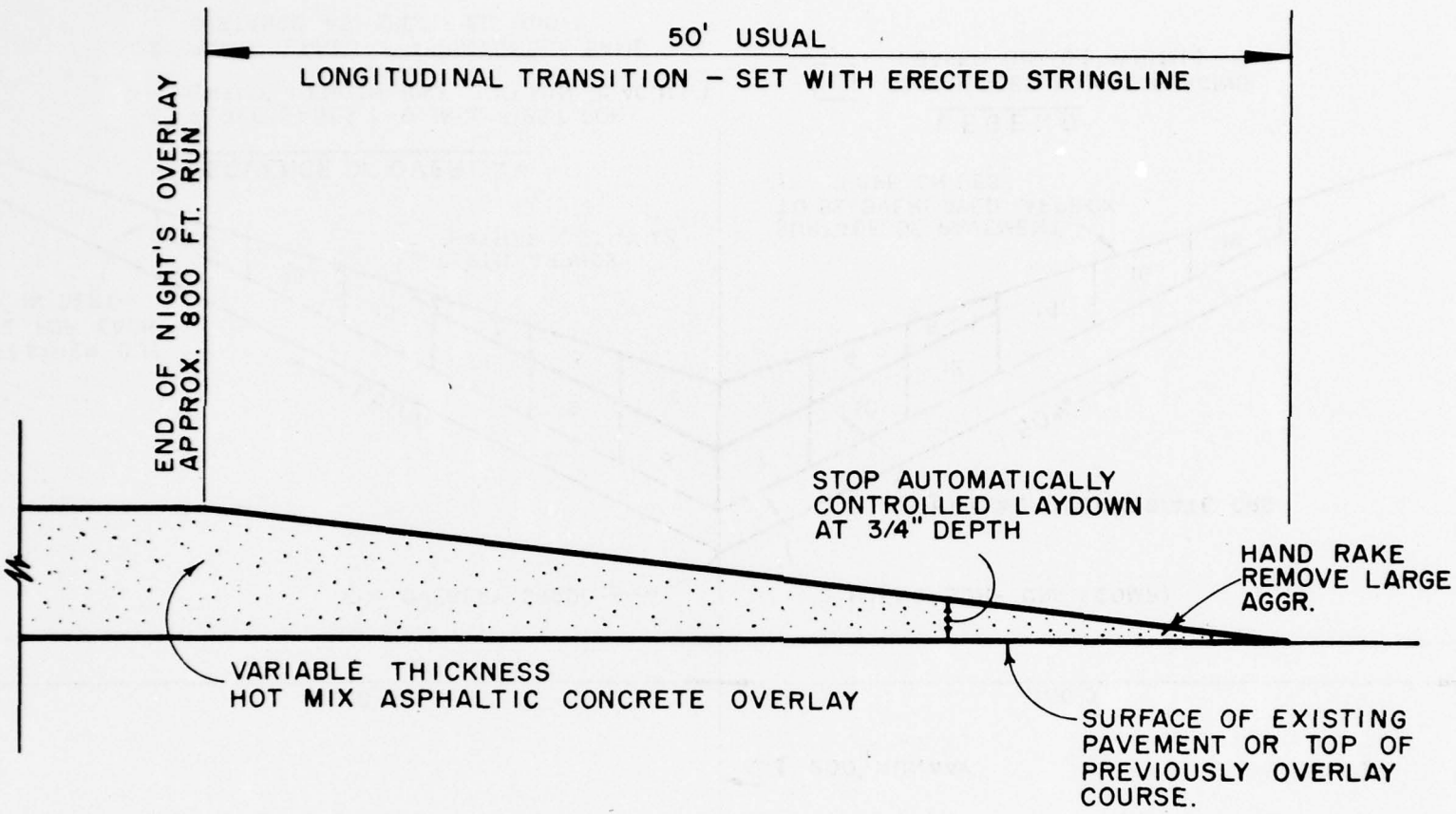


FIGURE 3 - TYPICAL LONGITUDINAL SECTION OF TRANSITION
(NOT TO SCALE)

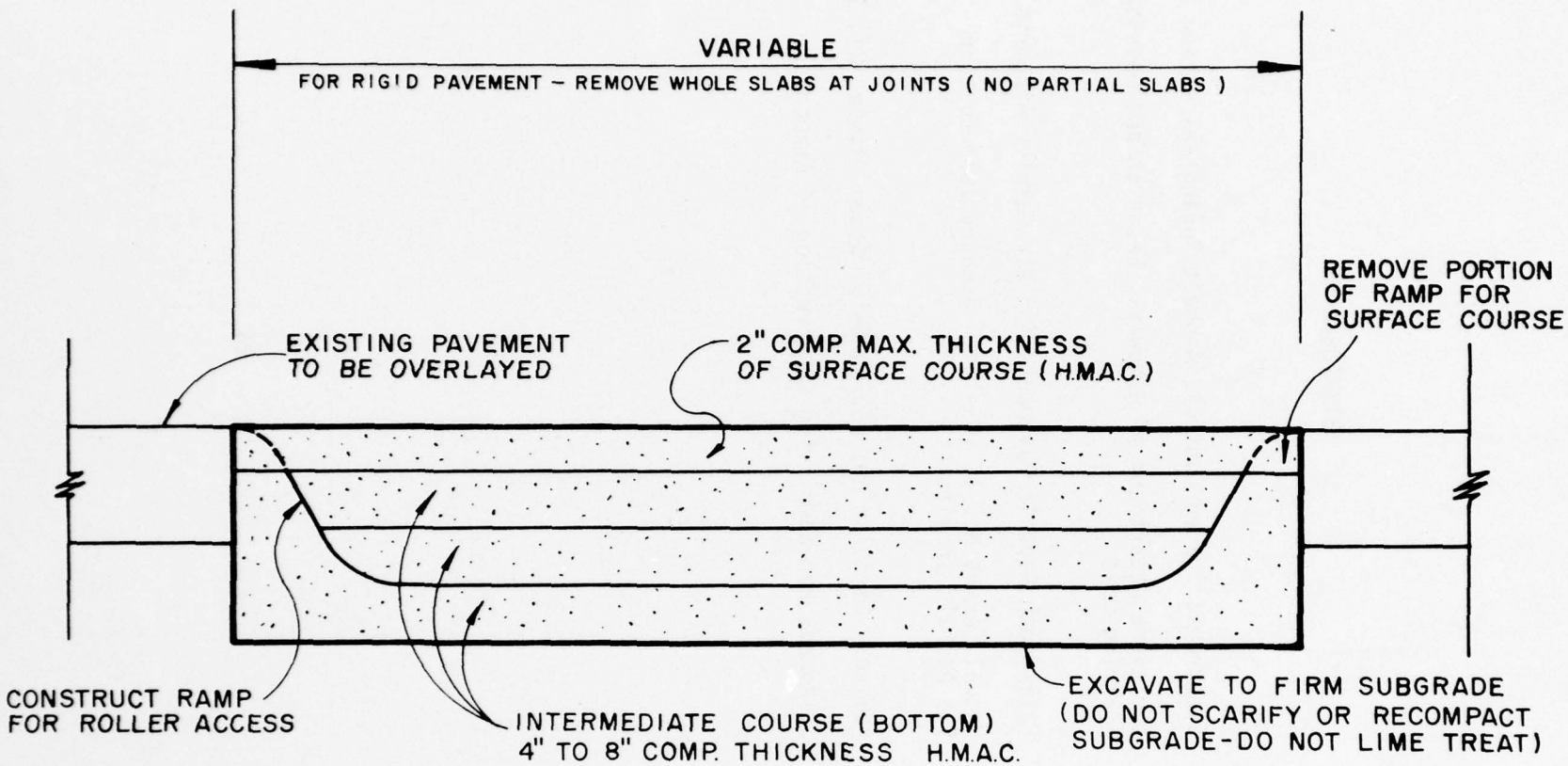


FIGURE 4 – TYPICAL PAVEMENT REPAIR SECTION
(NOT TO SCALE)

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